Celebrating 50 Years of Quality Research

NATIONAL MARINE FISHERIES SERVICE

HONOLULU LABORATORY

SOUTHWEST FISHERIES SCIENCE CENTER

1998
PROGRAM
REVIEW

1998 PROGRAM REVIEW

HONOLULU LABORATORY

U.S. Department of Commerce
National Marine Fisheries Service
Southwest Fisheries Science Center
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THE HONOLULU LABORATORY

The NMFS Honolulu Laboratory is celebrating its Golden Anniversary in 1998. During the past 50 years the Laboratory has had an illustrious history of performing fisheries exploration and development, conducting fisheries research, and providing scientific information and expertise in support of fisheries management and protected species recovery in the central and western Pacific. The following events will mark this special occasion throughout the year.

May 1998 – Session at the Tuna Conference regarding 50 years of tuna research at the Honolulu Laboratory.

September 1998 – Special session at the Eastern Pacific Oceanic Conference (EPOC) on the contributions made by the Laboratory to understanding the oceanography of the Pacific.

Open House aboard the NOAA ship *Townsend Cromwell.*

Open House at the Honolulu Laboratory followed by a staff and constituent party at the Waikiki Aquarium.

Special presentation at the Western Pacific Regional Fishery Management Council.

Geographic Area of Responsibility

The geographic area of responsibility of the Honolulu Laboratory is the largest of all U.S. fisheries laboratories. The vast area is bounded by the entire Hawaiian Archipelago in the north, American Samoa and U.S. possessions in the south, and the Marianas Archipelago in the west (Fig. 1). The area of these Exclusive Economic Zones (EEZ) is more than 1.7 million square nautical miles, which is equal to the total EEZ of the entire U.S. mainland (including Alaska).

Mission

The mission of the Honolulu Laboratory is linked to the NOAA Strategic Plan and to the Department of State priorities concerning international fisheries management in the Pacific:

NOAA Strategic Plan

- Build Sustainable Fisheries.
- Recover Protected Species.
- Maintain Healthy Living Marine Resource Habitats.

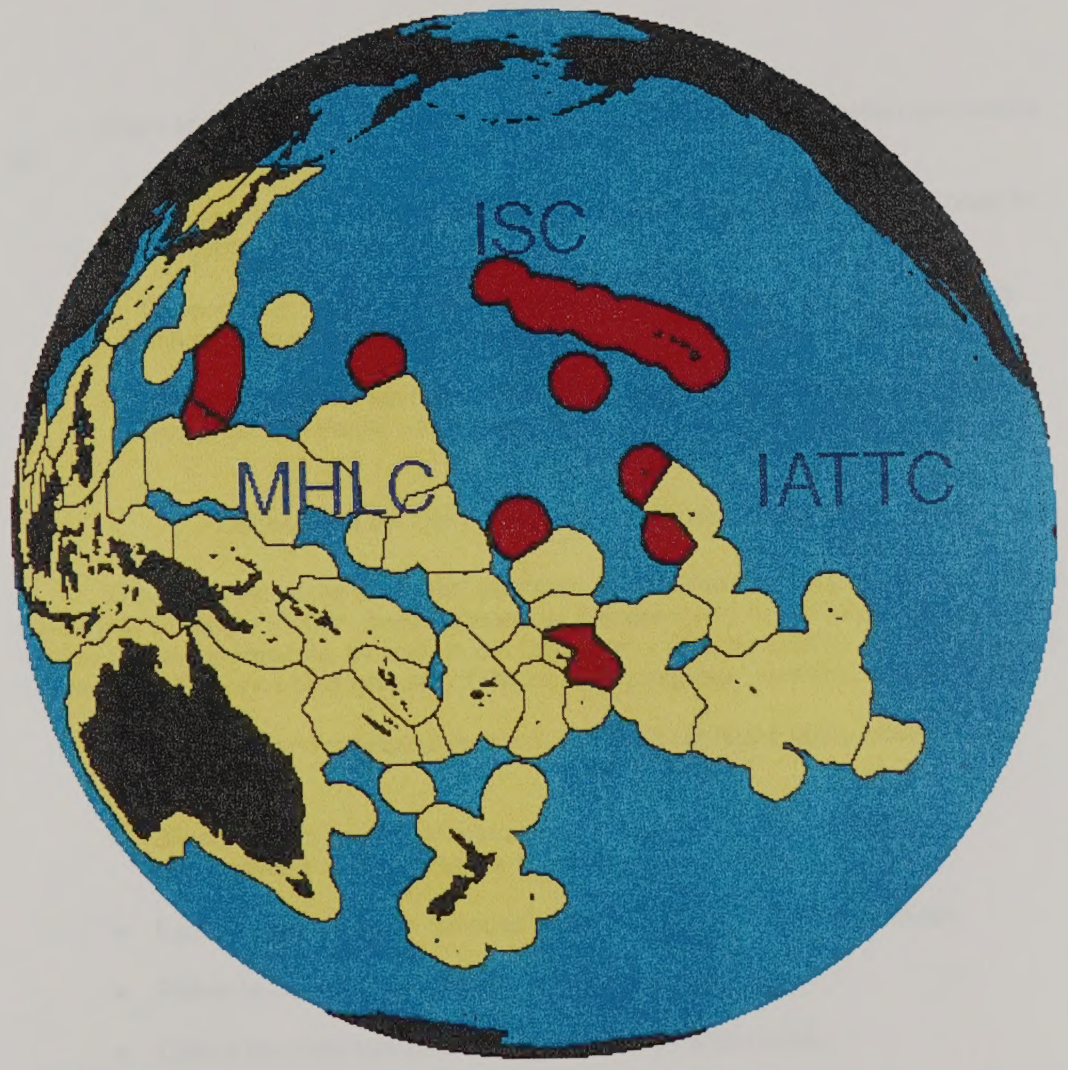


Figure 1. Honolulu Laboratory Area of Responsibility (in red) and the Pacific Ocean's three fisheries research and management domains--the Inter-American Tropical Tuna Commission (IATTC), the Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific (ISC), and the Multilateral High Level Conference (MHLC).

Courtesy
Pelagic Fisheries Research Program
University of Hawaii

Department of State Priority Issue

- International fisheries management of highly migratory species in the Pacific.

Goals

Goals of the Honolulu Laboratory are to provide scientific information and advice for

- Management of domestic fisheries in the U.S. Exclusive Economic Zones in the central and western Pacific.
- Support U.S. interests in the international management of highly migratory fish species in the Pacific Ocean.
- Recovery and management of the highly endangered Hawaiian monk seal and protected Pacific sea turtles.

Objectives of the Fisheries Research Program

The objectives of the Honolulu Laboratory's fisheries research program supporting the NOAA Strategic Plan to Build Sustainable Fisheries and to maintain Healthy Living Marine Resource Habitats, as well as the Department of State priority issue concerning International Fisheries Management of Pacific highly migratory species, include:

- Biological and ecological research in support of four Fishery Management Plans.
- Biological and ecological research in support of the international management of Pacific tunas and tuna-like species.
- Economic research on fisheries policy and management alternatives.
- Fisheries oceanography related to marine ecosystems.
- Collect fisheries statistics and monitor status of fisheries.

Approach to Fisheries Research and Management in the Western Pacific

In order not to repeat the experience of other regions in collapsing fisheries and the resulting significant negative economic consequences that have occurred in other areas of the U.S., a proactive approach to fisheries research and management must be followed in the western Pacific and Hawaii region. This course of action will

- Assure sustainability of the fisheries stocks.
- Ensure the viability and health of fisheries industries.
- Provide a significant source of cultural values and recreation for the region's diverse people.

Research in Support of Fishery Management Plans (FMPs)

Pelagic Fisheries of the Western Pacific FMP–This FMP regulates fishing for pelagic species including tunas, swordfish, marlins, sharks, mahimahi, opah (moonfish), ono (wahoo), and other pelagic species within the EEZs of U.S.-affiliated islands in the western Pacific. This includes the significant commercial domestic longline, troll, handline, and pole-and-line fisheries operating out of Hawaii, and the recently developing albacore longline fishery operating out of American Samoa. The Laboratory provides the following scientific information to the NMFS and the WPRFMC:

- Annual estimates of commercial and recreational pelagic landings.
- Fishery monitoring reports.
- Stock assessments.
- Economic research.

Primary research emphasis is placed on swordfish, where a multidisciplinary framework for identifying, prioritizing, conducting, and coordinating swordfish research is provided by the Laboratory's Swordfish Research Team. Research on bigeye tuna is being increased. Research is also conducted to evaluate interactions among central and western Pacific tuna fisheries and to evaluate the magnitude and fisheries ecosystem impacts of pelagic shark bycatch by the Hawaii-based longline fishery.

Crustacean Fisheries FMP of the Western Pacific–The Northwestern Hawaiian Islands (NWHI) trap fishery for spiny and slipper lobsters is managed under this FMP. The Honolulu Laboratory provides the NMFS SWR and WPRFMC with the following:

- Annual harvest guideline for the fishery.
- Annual stock assessment.
- Scientific advice and economic analyses for managing the fishery.

Laboratory scientists recently developed new methodology for determining the annual harvest guideline, annually assessing stock status, conducting research on lobster

recruitment and handling mortality, and performing economic analyses for evaluating alternative management actions. NWHI lobster stocks are rebuilding following an apparent recruitment failure in the late 1980s and early 1990s.

Bottomfish and Seamount Groundfish Fisheries FMP of the Western Pacific–Snapper, grouper, and jack species in American Samoa, Guam, Hawaii, and the Commonwealth of the Northern Mariana Islands (CNMI) are managed under this FMP. In addition, this FMP includes provisions for management of the Hancock Seamount armorhead resource.

In Hawaii, two bottomfish zones in the NWHI are regulated by the FMP. The Laboratory also assists the WPRFMC and the State of Hawaii with actions recently taken by the state to rebuild certain bottomfish stocks that have been overfished in the MHI. The Hancock Seamount armorhead fishery is closed to harvest, apparently due to overfishing by foreign fleets prior to the establishment of the FMP.

The Honolulu Laboratory provides the NMFS SWR, and WPRFMC with the following:

- Information on the status of stocks and fisheries for MHI and NWHI bottomfish.
- Economic analyses and evaluations of management.
- Information on the status of the Hancock Seamount armorhead stocks.
- Information on landings in the flag state bottomfish fisheries.

Honolulu Laboratory scientists primarily evaluate fishery and economic data to determine the health of the bottomfish stocks and fisheries. Bottomfish stocks in the NWHI covered by the FMP appear to be healthy, but several species in the MHI falling under State of Hawaii management jurisdiction are recruitment overfished.

Precious Coral FMP of the Western Pacific -Precious corals in this fishery include Pink Coral (*Corallium secundum*, *C. regale*, and *C. Laauense*) Gold Coral (*Gerardia spp.*, *Narella spp.* and *Calyptrophora spp.*) Bamboo coral (*Lepidisis olapa* and *Acanella spp.*) and Black Coral (*Antipathes dichotoma*, *A. grandis, A. ulex*). No permitted harvest has occurred in federal waters since 1978. Recently, a commercial venture has filed for a permit to begin precious coral harvests. The permit has been approved by the federal agencies and is currently pending approval from the State of Hawaii.

The Honolulu Laboratory provides the NMFS SWR and WPRFMC with the following:

- Evaluate potential interactions between the precious coral fishery and the endangered Hawaiian monk seal and its habitat.

Research in Support of International Fisheries Management

The mission of the Honolulu Laboratory has been expanded to include support for international management of highly migratory species in the Pacific. This has come about in response to several recent international fisheries agreements, notably the Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific (ISC), the new highly migratory species fisheries management organization under development in the southwest Pacific as the result of the Multilateral High Level meetings; the United Nations Agreement on Straddling and Highly Migratory Stocks; and the High-Seas Fisheries Compliance Act.

The objective of the Laboratory's efforts is to provide scientific advice and information to NMFS for supporting Department of State actions concerning the international management of tuna and tuna-like species in the Pacific. The Laboratory is playing a key role in the ISC, including leading cooperative international research on North Pacific swordfish and hosting the ISC meeting in January 1999. Since bigeye tuna and marlins are important in Hawaii-based fisheries, the Laboratory intends to be an active participant in research efforts related to these species as ISC programs on them are developed, as well as the ISC project concerning data needs on Pacific highly migratory species.

The Honolulu Laboratory is also increasing its involvement in the former western Pacific Yellowfin Working Group that has recently been expanded to include other species of highly migratory fishes.

Fisheries Oceanography Research Related to Marine Ecosystems

The goal of this research program is to develop understanding required to differentiate between variations in stocks of marine fishes and populations of protected species caused by natural fluctuations in marine environmental conditions and those caused by man: harvesting, pollution, loss of habitat, etc. Specifically, the program seeks to advance understanding of marine ecosystem dynamics with particular focus on the dynamics of the NWHI and Pacific pelagic ecosystems. The approach being followed involves the use of biological and physical data from research cruises, fisheries logbooks, ocean circulation models, and satellites to describe physical and biological dynamics and their links for NWHI and Pacific pelagic ecosystems. Results from this research program have applications in research dealing with swordfish, NWHI lobsters, bottomfish, and Hawaiian monk seals.

Fisheries Monitoring

Fisheries monitoring operations are critical for providing scientific advice to meet the Laboratory's mission. These operations involve three programs: fisheries statistics obtained from federal logbooks and shoreside monitoring of the Hawaii longline and lobster fisheries; a similar program coordinated with the NMFS SWR for the American Samoa longline fishery; and the Western Pacific Fishery Information Network (WPacFIN) which compiles state and territorial fisheries agency data. Laboratory investigators gather,

process, and manage databases from the Hawaii longline and lobster fisheries, Hawaii fish auctions, and various market sampling operations. WPacFIN is a cooperative federal-state program between NMFS and the four U.S.-associated Pacific Island entities who compile fisheries statistics from the island areas. The central WPacFIN site is located at the Honolulu Laboratory, which serves as the central database and the source of technical assistance in survey design and implementation, computer programming and statistical techniques, and data base management.

Objectives of the Protected Species Research and Recovery Program

The Honolulu Laboratory has two research programs supporting the NOAA Strategic Plan to Recover Protected Species–Hawaiian monk seal and Pacific sea turtles. In addition, the Laboratory is cooperating with the U.S. Fish and Wildlife Service (FWS) concerning fisheries interactions with seabirds.

The **objectives of the Hawaiian Monk Seal Recovery Program** include the following:

- Determine population status at main monk seal breeding sites.
- Identify and mitigate problems impeding population recovery.
- Conduct rehabilitation and relocation operations.
- Mitigate mobbing and its impact on population growth.
- Investigate pelagic ecology.
- Reduce entanglement by marine debris.
- Make recommendations for recovery and management.
- Coordinate and cooperate in intra- and inter-agency recovery efforts.

The **objectives of the Pacific Sea Turtle Recovery Program** include the following:

- Study biology, ecology, and natural history of Pacific sea turtles, with emphasis on the Hawaiian green sea turtle.
- Conduct research in support of the NMFS Biological Opinion concerning interactions between the Hawaii longline fishery and sea turtles.
- Develop models for assessing status of Pacific sea turtle populations.
- Investigate the fibropapilloma disease epidemic in green sea turtles.

- Provide technical assistance and training in the Pacific region to promote collections of reliable data on sea turtles.

The **objective of the research related to fisheries interactions with seabirds** is to investigate seabird mortality caused by longline fishing operations and estimates of seabird mortality using data from longline logbook and SWR sea turtle observer records. In addition, the Laboratory has received supplemental funding to conduct research on methods that may reduce seabird mortality in the Hawaii longline fishery.

HONOLULU LABORATORY BUDGET, STAFFING, AND ORGANIZATION

Honolulu Laboratory FY 1998 Budget

The FY 1998 budget for the Honolulu Laboratory is approximately $7.3 million. NMFS base funds allocated to the Laboratory by the SWFSC cover $3.9. million of this budget. The balance comes from several sources including NMFS add-on funds from F/PR and SWR amounting to about $2.1 million, from Congressional PPAs totaling about $1.1 million. A summary of the budget by funding source and selected programs is provided in Table 1.

Table 1. Honolulu Laboratory FY 1998 Budget

Funding Source	Amount ($1,000)
NMFS base	$3,913.9
NMFS add-on	
Monk seal	939.9
Sea turtle	514.1
WPacFIN	435.0
SWR support for PAO	
EFH	134.8
Precious Coral	10.7
Seabird	150.0
PPA	
Monk seal	523.0
Sea turtle	236.0
Swordfish	383.2
Other Funding	
CoastWatch (NESDIS)	113.0
TOTAL	$7,353.0

Honolulu Laboratory NOAA and UH/JIMAR Staff

The staff at the Honolulu Laboratory includes 54 NOAA/NMFS, 2 NOAA Corps officers, and 65 NOAA/UH Joint Institute for Marine and Atmospheric Research (JIMAR). Most of the UH/JIMAR staff members are funded by grants awarded by the Laboratory to the UH/JIMAR. Some of the UH/JIMAR staff members are supported from research proposals awarded competitively to Laboratory scientists by the JIMAR Pelagic Fisheries

Research Program (PFRP) (see section **Honolulu Laboratory Relationships with the University of Hawaii** for further discussion). Forty-three UH/JIMAR staff members are full-time, 15 are part-time, seasonal hires, or student assistants. The number of staff members by category appears in Table 2.

Table 2. Honolulu Laboratory NOAA and UH/JIMAR Staff

Organization	Number
NOAA	
NMFS	54
NOAA Corps	2
Total NOAA	56
UH/RCUH-JIMAR Staff	
Administration Staff	4
Fishery Oceanography	35
WPacFIN	11
CoastWatch	2
MARDAP	8
Pelagic Fishery Research Program	5
Full-time	43
Part-time	1
Seasonal hires	14
Student Assistant	7
Total non-NOAA	65
TOTAL	121

Honolulu Laboratory Organization

The Laboratory is organized into five research investigations (Fish Biology and Ecology; Ecosystems and Environment; Stock Assessment; Fishery Management and Performance; and Protected Species), and three other offices--Director's Office, Administrative Services, and Scientific Information and Technical Services. The latter group also includes the NOAA CoastWatch Site. An organization chart for the Laboratory is given in Figure 2: a listing of staff by investigation or program is given in Table 3.

Program Management and Research Teams

Program management at the Honolulu Laboratory follows a hybrid form of matrix management, with extensive interactions across five research investigations, which are organized on a functional basis.

The five research investigations and their programs include:

(1) Fish Biology and Ecology Investigation
- Fish Biology Program
- Life History Program
- Fish Ecology Program

(2) Ecosystem and Environment Investigation
- Fisheries Oceanography Program
- Ecosystem and Habitat Program

(3) Stock Assessment Investigation

(4) Fishery Management and Performance Investigation
Fishery Monitoring and Economics Program
- Fishery Data Management Program
- Western Pacific Fishery Information Network Program

(5) Protected Species Investigation
- Marine Mammal Research Program
- Marine Turtle Research Program

Teams are used to plan, conduct, and coordinate research projects as well as to ensure communications among all the parties involved. The Teams are made up of individuals from several or all of the Laboratory research investigations and service support groups. A heavy emphasis is placed on team-building training, which is provided by a consultant on contract.

The Laboratory's **teams** include:

(1) Investigation Chiefs Team
(2) Swordfish Research Team
(3) Oracle Development Team
(4) Lobster Research Team

Investigation Chiefs Team

This Team consists of the Laboratory Director, Chiefs of the five research investigations, the Administrative Officer, the head of Scientific Information and Technical Services, and the Director's program support assistant. The purpose of this Team is to serve as a board of directors for the Laboratory, to develop policy, to promote open communication among the operating units of the Laboratory, and to coordinate actions among the various groups as needed.

Swordfish Research Team

The goal of the Swordfish Research Team is to provide an operational multidisciplinary framework for identifying, prioritizing, conducting, and coordinating swordfish research. A comprehensive research plan encompassing fishery monitoring, stock assessment, and biological and fishery oceanography research has been developed by the team, which is comprised of scientists and managers from the Honolulu Laboratory, WPRFMC, and UH/JIMAR.

Oracle Database Development Team

The Oracle Database Development Team was established to ensure the coordinated conversion of Hawaiian monk seal, Pacific sea turtle, and pelagic fisheries data, as well as other fisheries and related data in the future within the Honolulu Laboratory Oracle database system. The team is being expanded to include website management and GIS development and will probably be renamed when its functions are in place.

Lobster Research Team

The Lobster Research Team was formed in response to the need to develop new methods for determining the annual harvest guideline (quota) for the NWHI lobster fishery for the efforts related to Amendment 9, and for research planning. The Team consists of scientists from the Honolulu Laboratory, UH/JIMAR, NMFS/SWR, and WPRFMC. Presently, the Team is primarily responsible for appraising the new harvest guideline procedures, planning lobster research, coordinating research activities, and advising the Laboratory Director on lobster research needs.

Scientific Information and Technical Support Services

The objectives of this group are to provide scientific and technical support for the Honolulu Laboratory and the SWR Pacific Islands Area Office (PIAO) as well, including:

- Computer hardware and software systems.
- Communications systems; e.g., Laboratory LAN, agency WAN, and data communication networks linked with the UH and NWS.
- Computer and communication systems security.
- High technology applications for data management and distribution including Oracle System, Website, and Geographic Information System (GIS).
- Library services.
- NOAA CoastWatch operations.

Director's Office and Administration

The primary objectives of the Director's Office are to provide overall scientific leadership and research direction, program management, and operational policy. In addition, the office is responsible for liaison with other NMFS and NOAA offices, WPRFMC, University of Hawaii, State of Hawaii, and other agencies and organizations.

The Administration group provides comprehensive administrative services for procurement, budget planning and implementation, fiscal monitoring, personnel management, travel, and facilities management. The editorial section of Administration provides scientific editorial and illustration services for the Honolulu Laboratory.

HONOLULU LABORATORY ORGANIZATION CHART

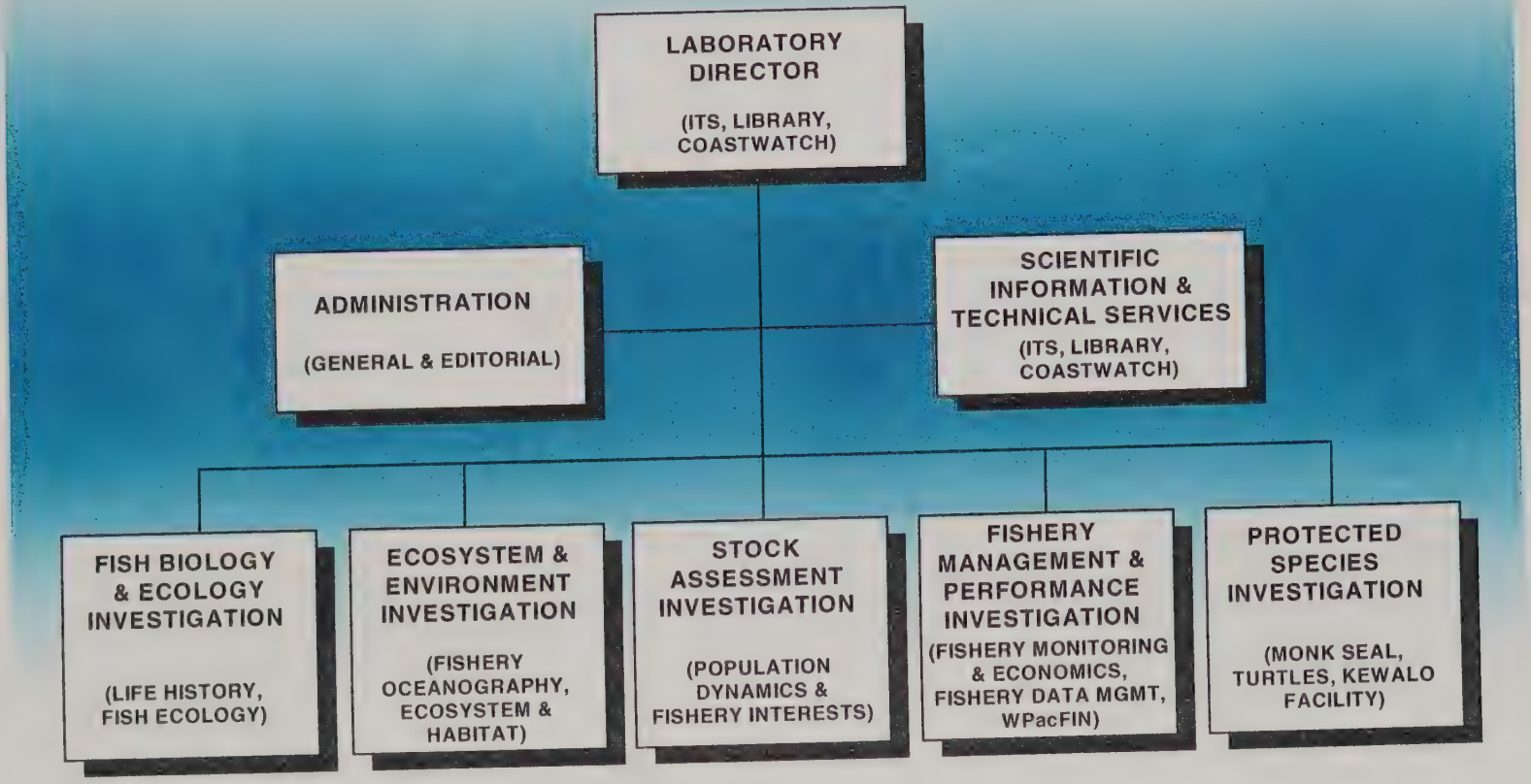

LABORATORY DIRECTOR
(ITS, LIBRARY, COASTWATCH)
ADMINISTRATION
(GENERAL & EDITORIAL)
SCIENTIFIC INFORMATION & TECHNICAL SERVICES
(ITS, LIBRARY, COASTWATCH)
FISH BIOLOGY & ECOLOGY INVESTIGATION
(LIFE HISTORY, FISH ECOLOGY)
ECOSYSTEM & ENVIRONMENT INVESTIGATION
(FISHERY OCEANOGRAPHY, ECOSYSTEM & HABITAT)
STOCK ASSESSMENT INVESTIGATION
(POPULATION DYNAMICS & FISHERY INTERESTS)
FISHERY MANAGEMENT & PERFORMANCE INVESTIGATION
(FISHERY MONITORING & ECONOMICS, FISHERY DATA MGMT, WPacFIN)
PROTECTED SPECIES INVESTIGATION
(MONK SEAL, TURTLES, KEWALO FACILITY)

TABLE 3. PERSONNEL, HONOLULU LABORATORY

DIRECTOR'S OFFICE
R. M. Laurs, Supvy. Oceanographer
L. Onosaki, Program Support Assistant
D. Foley, CoastWatch Coordinator*
E. Howell, Research Associate*
M. Parke, Computer Specialist*

ADMINISTRATION
S. Kamei, Administrative Officer
F. Fiust, Editorial Assistant
J. Kendig, Writer-Editor
J. Tamanaha, Purchasing Agent
G. Wong, Admin. Support Assistant
S. Wong, Budget Assistant
D. Yamaguchi, Scientific Illustrator
H. Gerboc, General Maintenance Assistant*
C. Kohan, Project Coordinator*
R. Orias, Student (P/T)*
S. Yamamoto, Student (P/T)*

SCIENTIFIC INFORMATION & TECHNICAL SERVICES
D. Tieman, Comp. Sys. Analy.
S. Abbott-Stout, Librarian
W. Higuchi, Computer Specialist
J. Pappas, Computer Specialist
R. Price, Computer Specialist
R. Uyeda, Computer Specialist
R. Yoshimoto, Computer Assistant

FISH BIOLOGY & ECOLOGY INVESTIGATION
C. Boggs, Supvy. Fishery Biologist
R. Chang, Fishery Biologist
E. DeMartini, Fishery Biologist
R. Humphreys, Fishery Biologist
T. Kazama, Fishery Biologist
R. Moffitt, Fishery Biologist
B. Mundy, Fishery Biologist
R. Nishimoto, Fishery Biologist
J. Sampaga, Bio. Sci. Tech. (Micro)
P. Shiota, Fishery Biologist
J. Uchiyama, Fishery Biologist
H. Williams, Bio. Sci. Tech. (Micro)
D. Curran, Fishery Biologist*
M. Musyl, Fishery Oceanographer*

ECOSYSTEM & ENVIRONMENT INVESTIGATION
J. Polovina, Math. Stat.
R. Brainard, NOAA Corps
D. Kobayashi, Fishery Biologist
F. Parrish, Fishery Biologist
M. Seki, Fishery Biologist
N. Ash, Bio. Research Technician*
K. Bitragunta, Oceanographic Assistant*
S. Murakami, Oceanographic Technician*

STOCK ASSESSMENT INVESTIGATION
J. Wetherall, Fishery Biologist
G. DiNardo, Fishery Biologist
P. Kleiber, Fishery Biologist
R. Skillman, Fishery Biologist
J. Dane, Computer Specialist*
W. Haight, Fishery Res. Spec.*
D. Kimball, Computer Specialist*
M. Labelle, Senior Researcher*
W. Walsh, Asst. Researcher*

FISHERY MANAGEMENT & PERFORMANCE INVESTIGATION
S. Pooley, Supvy. Industry Economist
F. Cabacungan, Computer Specialist
F. Dowdell, Computer Specialist
D. Hamm, Supvy. Comp. Spec.
R. Ito, Fishery Biologist
K. Kawamoto, Fishery Biologist
B. Kikkawa, Fishery Biologist
B. Miyamoto, Computer Specialist
M. Quach, Computer Specialist
D. Tagami, Operations Research Analyst
L. Tsukano, Computer Assistant
A. Carlos, Student (P/T)*
N. Chan, Data Entry/Processing Clerk*
M. Ching, Computer Specialist*
D. Gonzales, Computer Specialist*
C. Graham, Computer Specialist*
M. Hamilton, Research Associate*
J. Hoang, Computer Specialist*
L. Kim, Student (P/T)*
W. Machado, Fishery Assistant*
M. Pan, Graduate Research Associate*
J. Pitko, Computer Specialist*
P. Tao, Computer Specialist*
C. Tokita, Data Processing Clerk*

PROTECTED SPECIES INVESTIGATION
G. Antonelis, Supvy. Wildlife Biologist
J. Baker, Marine Biologist
G. Balazs, Zoologist
B. Becker, Wildlife Biologist
R. Dollar, Bio. Sci. Tech
J. Henderson, Fishery Biologist
T. Johanos-Kam, Wildlife Biologist
C. Sramek, NOAA Corps
A. Aguirre, Epidemiologist*
R. Boland, Biological Technician*
R. Castillo, Student (P/T)*
M. Craig, Research Associate*
S. Eames, Data Entry Clerk*
D. Ellis, Research Associate*
L. Kashinksy, Vet. Medical Technician*
S. Maldonado, Jr., Bio. Res. Assistant*
S. Murakawa, Research Associate*
B. Ryon, Biological Technician*
M. Shaw, Biological Research Technician*
H. Swensen, Computer Specialist*
C. Yoshinaga, Logistic Coordinator*

14 seasonal hires and 7 student assistants not included

*JIMAR

Honolulu Laboratory Relationships with the University of Hawaii

The Honolulu Laboratory is located on the University of Hawaii (UH) Manoa campus. It has extensive relations with the University, resulting in significant mutual benefits. Several of the Laboratory's senior investigators hold UH adjunct professorship or senior research fellow positions, lecture UH courses in marine science and related topics, and serve as scientific advisers to undergraduate and graduate students. UH students serve as a source of talented and motivated temporary help for the Laboratory. The Laboratory computer Internet access and other computer communications are handled through the UH Computer Center and the NOAA ship assigned to the Laboratory, *Townsend Cromwell*, which is berthed and receives port support from the UH. The UH also provides some environmental compliance maintenance for the Laboratory as well as after-hours security. Most direct associations between the Laboratory and the UH are through the NOAA/UH Joint Institute for Marine and Atmospheric Research (JIMAR).

Joint Institute for Marine and Atmospheric Research (UH/JIMAR)

The Laboratory has many interactions with the UH/JIMAR including the opportunity for Laboratory scientists to compete for pelagic fisheries research funding that is awarded competitively by the JIMAR/PFRP. The JIMAR/PFRP administers funding received from a Congressional funding. Laboratory scientists have successfully competed for JIMAR pelagic fisheries research funds and over the past 5 years have served as Principal or Co-Principal Investigators on nine projects totaling $1.9 million. In addition, substantial complementary, collaborative, and cooperative research on pelagic fisheries is conducted by Laboratory and UH/JIMAR scientists.

The Laboratory utilizes the NOAA/UH Joint Institute program by awarding grants to JIMAR for research in support of the mission of the Laboratory. In FY 1998 the Laboratory awarded a grant totaling nearly $1.65 million to JIMAR to support research and operations at the Laboratory. A summary of the funding by projects is provided in Table 4. The Laboratory also participates in the JIMAR visiting scientist program.

Table 4. Honolulu Laboratory Funds Awarded to UH/JIMAR in FY 1998 ($1,000)

Programs	Amounts	Total
Fisheries Visiting Scientist Program	40.0	40.0
Fishery Oceanography		828.0
Pacific Swordfish Research	124.0	
Recovery of Hawaiian Monk Seal	578.0	
Pacific Sea Turtle Biology and Ecology	126.0	
Application of Satellite Remote Sensing to Pacific Highly Migratory Species	37.0	37.0
Western Pacific Fishery Information Network Project	320.0	320.0
Marine Resource Dynamics and Assessment Program (MARDAP)		370.0
Sea Turtle Assessment and Monitoring	49.0	
Research Support	143.0	
Geographic Information System for Fisheries Database System	38.0	
Seabird Assessment	140.0	
NOAA CoastWatch Operations	60.0	60.0
		$1,655

*SWR/PAO

Publications and Scientific Meeting Presentations

Nineteen manuscripts have been approved, submitted for publication, in press, or published by Laboratory scientists since October 1, 1997. The number of publications by category are:

Fishery biology/ecology - 3
Fisheries and fishery interactions – 3
Physical and biological oceanography – 2
Hawaiian monk seals – 4
Sea turtles – 6
Fisheries economics and social science – 1

The Laboratory staff also prepared 35 administrative reports, abstracts, and workshop proceedings.

Laboratory scientists gave 28 presentations at 50 scientific meetings and gave

numerous presentations at the WPRFMC Plan Team, Science and Technical Committees, and full council meeting.

NOAA CoastWatch

The NOAA CoastWatch site, which is funded by a contract with NOAA/NESDIS, is located at the Honolulu Laboratory. The site has direct readout of NOAA satellites (shared with NOAA/NWS) and satellite image processing systems. Satellite-derived ocean temperature data products are produced at the CoastWatch site for distribution to federal, state, and local agency and university researchers involved in marine science, policy, and management. CoastWatch data products are increasing in use in Honolulu Laboratory fisheries and protected species research. Over the past year, there has been a significant expansion in the amount of satellite information available from the CoastWatch Site, including ocean circulation and ocean color products.

ISSUES AND NEEDS

International Management of Highly Migratory Species

Background Information

The development of arrangements for international management of highly migratory species (HMS) in the Pacific has a significant influence on research programs at the Honolulu Laboratory. In the North Pacific, the Interim Scientific Committee for Tuna and Tuna-like Species (ISC), formed in 1995, has begun activities through ISC Working Groups responsible for developing data exchange protocols and coordinating research on highly migratory species. In the South Pacific, the Multilateral High-Level Conference on the Conservation and Management of Highly Migratory Species (MHLC) has convened two consultations in Honiara, Solomon Islands, and will hold its third meeting in Tokyo June 22-26, 1998. Thus far the MHLC has had little impact on Laboratory programs. ISC matters, on the other hand, have been given significant attention here.

An effect of HMS management developments will be to alter the focus of pelagic fishery monitoring and research activities at the Honolulu Laboratory. For example, under the ISC, and presumably the MHLC, there will be new obligations for timely and accurate reporting of fishing effort and catch and exchange of official fishery data between the U.S. and other member states. These obligations will necessitate greater investment in the collection, compilation, quality assurance, and documentation of data maintained by NMFS and development of information systems to support access to NMFS data bases (see separate reports on data access issue and fishery monitoring issue). At the same time, the HMS management agreements will provide opportunities for the Laboratory to establish the multinational collaborations essential for effective HMS stock assessment and research.

Laboratory Actions in Response to the Issue

The majority of Laboratory research is focused on swordfish. In addition, research is conducted on bigeye tuna and blue shark. The swordfish activities include the following:

- Establishing and implementing a comprehensive swordfish research program.
- Hosting the Second International Swordfish Symposium during March 1997.
- Establishing a U.S.-Japan collaboration to conduct a Pacific swordfish stock assessment and related research, including exchange of historical swordfish fishery data.
- Initiating plans to host the second meeting of the ISC in Honolulu during January 15-23, 1999, including ISC plenary and working group sessions. The U.S. has leadership of the ISC Working Group on Swordfish.
- Supporting JIMAR projects on tuna and billfishes.

Approach

- Swordfish research is planned and coordinated through the Honolulu Laboratory Swordfish Research Team. The team has drafted a strategic plan that presents the team's mission statement, objectives, strategic linkages, and major research activities in five areas: (1) Population modeling and assessment; (2) Reproduction, Age and Growth; (3) Ecosystem and Environment; (4) Fleet Dynamics and Economics; and (5) Monitoring, Sampling, and Data.

- The informal arrangement between HL scientists and colleagues at Japan's National Research Institute of Far Seas Fisheries (NRIFSF) provides for the exchange of data to support specific, agreed objectives in swordfish stock assessment and other kinds of support for research collaboration (e.g., hosting of visiting scientists).

- Catches and landings of HMS by U.S. fisheries in Hawaii, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands are monitored and reported by the HL WPacFIN Program.

- Data to characterize the foraging habitat of swordfish in the North Pacific transition zone ecosystem are being collected and will be used to describe swordfish essential fish habitat (EFH).

- Planning is underway to conduct research cruises aimed at characterizing bigeye tuna EFH around the Hawaiian Islands.

- Conventional tagging and tracking programs for swordfish and archival tagging programs for swordfish and bigeye tuna have been established.

- The Laboratory is involved in a Pacific-wide effort to assess swordfish stock structure using genetic techniques.

- Annual participation in/hosting of the Tuna Conference.

- Development of "pop-up" satellite transmitting archival tags in collaboration with CSIRO scientists in Hobart, Tasmania.

Results

- Swordfish Size-At-Sexual-Maturity and Sex Ratios.

  Body sizes at median sexual maturity are 102 and 143 cm eye-to-fork length for males and females, respectively. Sex ratios (females/total) predictably increase with body lengths > 100 cm EFL, and above 220 cm EFL virtually all swordfish are female.

- Swordfish Age and Growth Studies.

  Analyses of daily microincrements in otoliths (sagittae) indicate that swordfish on average grow to about 100 cm EFL by age-I. Analyses of annular features in anal fin ray cross-sections indicate that, like swordfish in the Atlantic, females live longer and grow faster (at least partly because of females' extended period of relatively fast, juvenile growth) than males in the Pacific.

- Swordfish Essential Fish Habitat.

  Oceanographic cruises, TOPEX/Poseidon satellite altimetry, and SeaWiFS ocean color show that the swordfish fishery is associated with the southern branch of the Subtropical Frontal Zone characterized by an eastward geostrophic meander and subsurface chlorophyll maximum. Larger-bodied (mostly female) swordfish predominate in catches made at and above lat. 27°N; smaller-bodied (mostly male) catches predominate below 22°N.

- Swordfish symposium.

  Approximately 200 people, representing seven countries, participated in the *Second International Swordfish Symposium*. Thorough descriptions of swordfish fisheries were presented by representatives from the U.S.A., Japan, Mexico, Chile, Australia, and the delegation from Reunion. A report on the Atlantic "experience" was presented by an ICCAT representative, and an Expert Panel was convened to discuss stock assessment approaches and data needs. Three concurrent working group sessions were held, focusing on specific themes: Biological Input to Stock Assessment, Fisheries Oceanography and Habitat, and Resource Assessment and Monitoring. The conclusions and recommendations drawn from this symposium will benefit research conducted on Pacific swordfish through the identification and advancement of methodologies in each of the research areas. The results are also applicable to swordfish research in other oceans. The steering committee, chaired by Gerard DiNardo, is finalizing the proceedings of the Symposium.

- Swordfish stock assessment.

  Jerry Wetherall and other SWFSC staff assembled swordfish fishery data from Hawaii and U.S. west coast states (via the PacFIN database) and established a secure FTP server at the Honolulu Laboratory to enable colleagues at NRIFSF to access the U.S. data. As part of the Honolulu Laboratory-NRIFSF data exchange agreement, Laboratory stock assessment scientists were provided historical swordfish catch and effort statistics for the Japanese longline fishery from 1952 through1996 via the FTP site. The Laboratory and NRIFSF are conducting a collaborative stock assessment of swordfish with the objective of providing results to the ISC in January 1999.

- Tagging.

  Since 1990 approximately 500 swordfish have been tagged with conventional tags and released. To date five tagged swordfish have been recovered. In 1998 approximately 24 bigeye tuna have been tagged and released with archival tags.

- Stock Structure.

  The Laboratory is involved in a Pacific-wide effort to assess swordfish stock structure using genetic techniques. Since March 1997, approximately 300 swordfish tissue samples have been collected and shipped to the IATTC for genetic analysis. The IATTC also receives samples from Ecuador, Chile, and Mexico.

Plans

- Implement HL swordfish research plan during FY 1999.
- Conduct a cooperative multinational Pacific swordfish stock assessment.
- Develop a generic computer simulation framework for assessing swordfish stock status and fishery management options.
- Host January 1999 ISC meeting in Honolulu.
- Convene 1999 meeting of ISC Swordfish Working Group.
- Participate in ISC Statistics Working Group.
- Continue the collection of biological samples for life history and population biology research.
- Continue tracking and tagging efforts on swordfish and bigeye tuna

Pending Issues

The Honolulu Laboratory's role and responsibilities in pursuing HMS research, and how this research will be integrated into the strategic plan of NMFS, are not well defined. Further action is needed on a number of issues, including:

- A coherent framework (international and domestic) for conducting research on HMS throughout their range.
- Specific plans defining the responsibilities of the SWR and SWFSC entities in HMS activities.
- More effective communication of HMS information to the various parties.

Although these issues have been discussed at previous strategic planning meetings (Bahia Hotel and Dana Point meetings) they have not been fully resolved. As a first step, action should be taken on issues discussed at the previous strategic planning meetings.

Hawaii Longline Fishery Issues

Shark Finning

Background Information--Although there is no targeted fishery for sharks in Hawaii and the central and western Pacific, large numbers of sharks are caught incidental to hook-and-line fisheries operating in the region. There is relatively complete information regarding the catch of sharks by the Hawaii longline fishery, but virtually no information available for other fisheries; e.g., bottomfish fisheries. On a numerical basis, sharks are the dominant species taken by the Hawaii longline fishery and comprise about one-third of the total catch of all species reported in logbook records. During 1991-97, logbook data show that the number of sharks caught by the longline fishery ranged from approximately 71,200 to 154,600, and in each of the past 3 years was between about 86,800 and 102,000 (Fig. 1). Blue sharks constitute about 95% of the sharks caught, with mako, thresher, and various other species making up the balance.

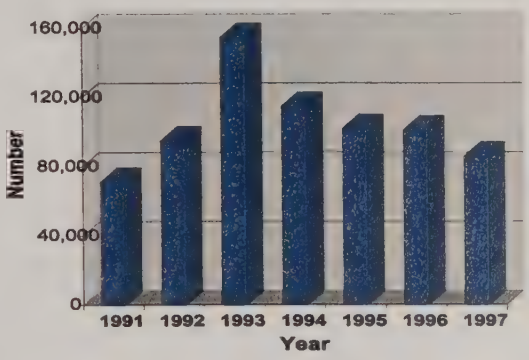


Figure 1. Number of sharks caught by the Hawaii longline fishery.

A portion of the sharks that are caught in the longline fishery are released by fishermen. Observer records indicate that approximately 80% of these are alive at the time of release. However, the proportion of sharks released has decreased significantly, primarily in response to an increased market for shark fins. In 1991 and 1992 only about 3.5% of the sharks caught were retained. By 1994 this value increased to 14.4%, in 1995 to 33.2%, in 1996 to 43.3%, and in 1997, to 57.5% (Fig. 2). Most of the sharks that are kept are killed and then "finned", and only a few number are landed for the flesh. After sharks are finned, most of the carcasses are dumped at sea. This perceived "wastage", along with concerns about potential overfishing of shark stocks, has raised concerns among conservation groups, some fishermen, and to a limited degree the public. Shark finning is a potentially serious issue for the Hawaii longline fishery. It appears likely that management actions will have to be taken to limit or stop the practice of shark finning. If not, there could be increasing public pressure to stop or limit the fishery.

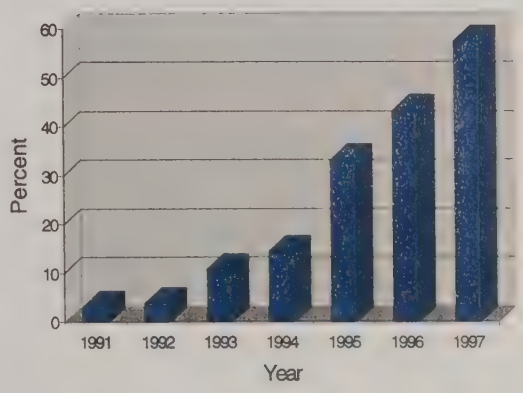


Figure 2. Percent of sharks kept for processing.

Laboratory Actions in Response to the Issue--The Honolulu Laboratory shark research supports the NOAA Fisheries strategic goal, "build sustainable fisheries." The goal of the research is to assure healthy populations of pelagic sharks in the central and western Pacific region. The research activities include:

- Estimate incidental catch of sharks taken in the Hawaii longline fishery.
- Evaluate performance of logbook records for assessing shark catch.
- Conduct research on shark population biology in support of stock assessment.
- Initiate research on impacts of longline fisheries on Pacific blue shark stocks.

Approach

- Use logbook records and landings information to estimate quarterly and annual catch and disposition of sharks taken by the types of the longline fishing operations; e.g., tuna, swordfish, mixed.
- Monitor landings of sharks sold for human consumption at the Honolulu auction.
- Use observer data to evaluate longline logbook records for estimating shark catch, condition of sharks released, and information on shark species composition.
- Use logbook and observer records to conduct research on improving methods for estimating shark CPUE; e.g., cluster analysis.
- Collect data needed for shark population biology research on research cruises, including shark tag-and-release on an opportunistic basis.
- Conduct blue shark population assessment research in cooperation with the Japanese.
- Use regression-tree methods to evaluate fishing factors that may affect shark catch.
- Informally monitor landings of shark fins taken by the domestic fishery and by the foreign longline fisheries that are transshipped through Honolulu.

Results

- Trends in total shark catch.

  Annual catches of sharks by the longline fishery are shown in Fig. 1. The total shark catch peaked at 154,600 in 1993 and then showed a slow decline to

86,800 in 1997. The variations in total catch are believed to be related principally to changes in targeting for primary species taken by the fishery.

- Trends in shark catch by type of fishing trip.

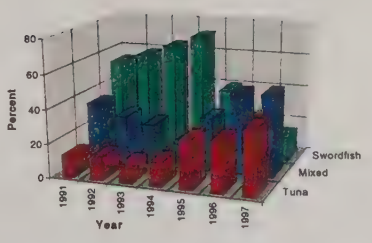


Figure 3. Percent of total shark catch by type of fishing trip.

During 1991-95, swordfish fishing trips accounted for the majority of the total shark catch. However, in 1996 significant changes in he proportions of sharks caught occurred by trip type: total percentages of sharks taken dropped sharply in the swordfish fishery while abruptly increasing on tuna and mixed fishing trips (Fig. 3).

- Trends in shark finning .

The proportion of sharks caught that are finned has increased over sixteenfold during the last 7 years. In 1991 and 1992 only about 3.5% of the sharks caught were finned, but the value has steadily increased, and by 1997 it was 57.5% (Fig. 2).

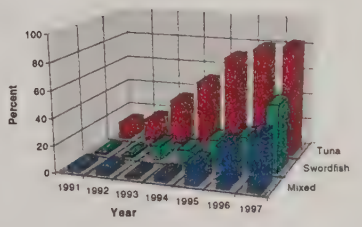


Figure 4. Percent of shark catch processed by type of fishing trip.

- Trends in the proportion of sharks finned by type of fishery.

The highest rate of shark finning occurs on fishing trips targeting tuna. The proportion of sharks caught that are finned by this segment of the longline fishery has increased substantially from 12.5% in 1991 to 83.9% in 1997. The rates of shark finning on the mixed and swordfish types of fishing trips have also increased but are much less than that for tuna trips (Fig. 4).

- Cluster analysis findings.

The objective of this research is to identify clusters of longline sets that have similar catch composition. Then fishing effort is lumped by clusters for calculation of CPUE. This information is being used in evaluations of longline fishery effects on the population status of the blue shark. The blue shark comprises approximately 95% of the sharks caught in the Hawaii-based fishery as well as in most other Pacific pelagic longline fisheries. Three clusters representing three types of fishing were defined, one with sharks dominant and two with sharks present as minor species. The first cluster, and the most consistent in its catch composition, was dominated by blue shark and swordfish. The other two clusters were bigeye tuna and albacore and swordfish and bigeye tuna, each with sharks as lesser components.

- Trends in blue shark CPUE.

Plots of CPUE for each of the clusters containing blue sharks (Fig. 5), as well

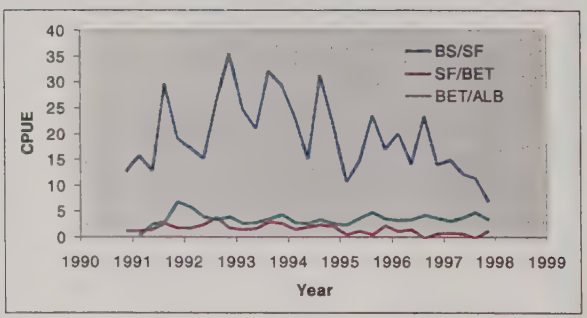


Figure 5. Blue shark CPUE trends by type of cluster.

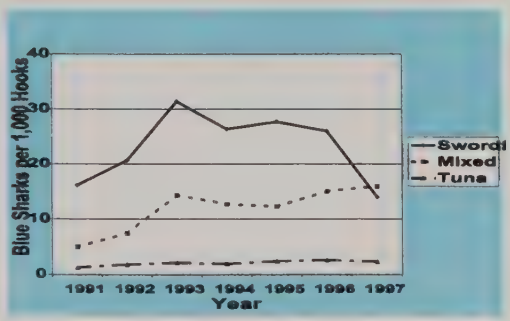


Figure 6. Blue shark CPUE by type of fishing trip.

as for catch (not shown) exhibit pronounced seasonal variations. The CPUE time-series indicates no evidence of long-term changes in population status of blue shark. Annual CPUE plots for blue shark for each of the type of fishing gears (Fig. 6) generally show an upward trend for all types of fishing trips, except for swordfish in 1997. The latter CPUE value may be anomalous because of very low effort directed for swordfish in 1997. The CPUE values should be viewed in the context of the Hawaii-based longline fishery setting 14 to 15 million hooks annually and catching less than 5,000 tons of blue sharks, while other longline fisheries in the Pacific set a total of 710 million hooks and catch an estimated 148,000 tons of blue sharks.

- Performance of logbook records for assessing shark catch by the longline fishery.

Comparison of data on shark catch in logbook records with similar data in observer records, indicates that logbook data provide a relatively good estimate of shark catch made by the Hawaii longline fishery. The study showed that for some sets shark catches may be either somewhat understated or overstated, and that overall logbook data underreported shark catch by less than 10%.

Plans–The research noted under the Approach category will be continued in FY 1999. In addition the following studies will be conducted.

- Conduct stock assessment in collaboration with Japanese and possibly other foreign investigators.

- Expand field research to obtain additional population biology data.

- Use "pop-up" satellite transmitting archival tags to investigate blue shark biology and ecology.

Resources

- FY 1998

  One staff-year labor funded by JIMAR/PFRP funding (this funding runs out November 30, 1998); approximately one staff-year NMFS labor; and 0.25 staff-year of visiting shark expert from Japan who will work with Laboratory researchers in Honolulu. Field research will also be piggy-backed on swordfish and tuna ecology research cruises.

- FY 1999

  Two staff-years NMFS labor; will submit new proposal for UH/PFRP funds. Expanded research at sea including dedicated 30-day cruise as well as piggy-back operations on highly migratory species research cruises.

Hawaiian Longline Fishery Issues

Interaction of Hawaii Longline Fishery with Sea Turtles

Background Information–While fishing for swordfish or tuna, Hawaii longline fishing vessels incidentally hook or entangle sea turtles, causing an unknown level of mortality to affected turtle populations. Under the 1994 Biological Opinion concerning the fishery, NMFS is required to estimate the levels of turtle take and mortality and seek ways to eliminate or reduce them. Reduction of incidental fishing mortality (and other types of human-caused mortality) "to biologically insignificant levels" is a key performance measure of the NOAA Fisheries Strategic Plan and one of the actions identified in the six U.S. Pacific Sea Turtle Recovery Plans now being implemented by NMFS and the USFWS.

Laboratory Actions in Response to the Issue–Supported in part by Recover Protected Species (RPS) funding, the Honolulu Laboratory undertakes research on several aspects of the longline-sea turtle interaction issue:

- Estimation of take and mortality levels by species.
- Review of statistical methods for take estimation.
- Identification of factors and mechanisms that influence the likelihood of longline gear interactions with sea turtles and that could be manipulated or exploited to reduce or eliminate takes; e.g., longline gear configuration, time and location of fishing, environmental conditions, and distribution of target fish species and sea turtles.
- Development of quantitative methods to assess impacts of incidental fishing mortality on turtle population dynamics and recovery.
- Collection and coordination of turtle tissue samples for genetic analysis to determine which populations (nesting colonies) of turtles are involved with the Hawaii longline fishery and in what proportions.
- Application of satellite transmitters to sea turtles caught in longline gear and released to collect information about the post-hooking mortality, movement and habitats of the turtles.

Approach

- Data collected by SWR observers and data reported by longline fishermen in mandatory logbooks are combined to develop regression-tree models predicting the take and mortality of each turtle species per longline set. Predicted takes and mortalities per set are expanded using reported logbook effort to estimate total annual takes and kills. The estimates are provided to the SWR for inclusion in an annual NMFS report required under the Biological Opinion.

- The effects of various factors on average take per set, such as location of fishing, depth of hooks, use of chemical light sticks, sea surface temperature, and fish catch composition are explicitly evaluated as part of the regression-tree analysis.

- Computer simulation models of sea turtle population dynamics are being developed that incorporate life history attributes and available historical data on levels of human-caused mortality; e.g., egg harvest, mortality of nesting females, and incidental fishing mortality. These models are used to determine the relative effects of different mortality sources on population status and evaluate recovery management strategies.

- George Balazs of the Laboratory provides skin biopsy kits and training to SWR longline observers and forwards biopsy samples collected by observers to Peter Dutton, SWFSC/La Jolla, for genetic analysis to determine natal origins of turtles taken in the fishery.

- Observers are supplied with satellite transmitter kits and taught how to attach them. Balazs monitors the tracks of turtles released with transmitters via the Argos polar-orbiting satellites. Paths taken by turtles are plotted over concurrent information about the pelagic environment, including patterns of temperature and flow at the sea surface (from satellite remote sensing) in collaboration with Honolulu Laboratory scientists Jeff Polovina and Don Kobayashi.

Results

- Estimates of take and mortality

  Statistical models were constructed using observer data and corresponding logbook data from each observed set during 1994-97 to predict the takes of each turtle species per longline set. Predicted takes per set were extrapolated using logbook records of total longline effort to estimate total turtle takes by species on an annual basis, 1991-97. The total turtle mortality caused by longline interactions was estimated for each species by multiplying the estimated total take by average kills per take, the latter calculated from observer data and other information. Uncertainty in the take and kill estimates was computed by generating empirical bootstrap distributions of take and kill estimates. The bootstrap distributions enabled inferences about the probability that actual takes and kills exceeded levels allowed under the current Biological Opinion Incidental Take Statement. Estimates of takes are given in Figures 1-4. For loggerheads, the total take during 1997 was estimated at 284, with an estimated probability of 0.22 that the true total take exceeded the allowed level of 305. In other years, 1991-96, there is at least a 59% chance that the currently allowed loggerhead take level was exceeded. Similarly, point estimates of loggerhead kills for each year, 1991-97, have been greater than the allowed incidental mortality level. In the case of olive ridleys, estimated takes have not exceeded allowed levels (Fig. 2), but estimated mortalities

have. Estimated takes and mortalities of leatherbacks (Fig. 3) and green turtles (Fig. 4) have been well below allowed levels in all years. No hawksbills have yet been encountered by observers.

- Workshop on take estimation methods

  The Honolulu Laboratory convened a workshop in April 1998 to review and discuss statistical methods for estimating takes of sea turtles and seabirds in longline fisheries. Besides the Hawaii longline fishery, the case studies examined at the workshop included the U.S. longline fishery for tuna, swordfish, and sharks in the northeastern Atlantic and Gulf of Mexico, the Japanese longline fishery for southern bluefin tuna off Australia, and the U.S. longline fishery for groundfish in the Bering Sea and Gulf of Alaska. The exchange of views and experiences with different approaches to take estimation was extremely fruitful. The Honolulu Laboratory's approach of fitting regression-tree models to observer and logbook data, expanding by the total fleet effort, and using bootstrap distributions to infer probabilities of the true take levels, appears to be at the "cutting edge" of take estimation methodology. Statistical issues related to the design and implementation of observer programs were also discussed at the workshop. More effective deployment of observers and allocation of observers' time at sea will require that sampling requirements of the many competing monitoring objectives be determined (e.g., sample sizes needed for sea turtle take monitoring, seabird take monitoring, marine mammal monitoring, and fish catch sampling).

- Factors influencing take

  The regression-tree analyses of loggerhead take per set considered only those potential predictors recorded in the observer and logbook databases. Of these simple predictors, the ones providing the greatest explanatory power appear to be proxies for a complex set of conditions that cause fishing effort to occur where there are loggerheads. The main predictors of loggerhead take per set have been latitude or sea surface temperature, or both. For example, in the 1998 analysis a relatively high loggerhead take per set was predicted for gear set in waters cooler than 20°C or waters north of 29°N. These predictors are highly correlated with each other and both signify fishing in the subtropical frontal zone north of the Hawaiian Archipelago. Here loggerheads appear to occur in relatively high density, either using the zone as a migration corridor or attracted by foraging opportunities in convergences at or near the sea surface. The frontal zone is also where swordfish catch rates are high at certain times of the year, attracting longline fishing effort directed at swordfish. Linkages between the conditions defining good swordfish fishing grounds and those creating high densities of loggerheads are being sought. These studies are combining observer data, logbook statistics, oceanographic data (SST, TOPEX flow fields, ocean color), and loggerhead movement data (from satellite transmitters).

- Impact assessment models

  The prototype turtle population simulator TURTSIM was used in 1997 to provide general indications of Hawaii longline fishery impacts on Japanese loggerheads and leatherbacks from Mexico and other Pacific nesting locales. The TURTSIM results were disseminated to F/PR and SWR as background information for NMFS' Section 7 consultation on the Hawaii longline fishery. Studies to improve the TURTSIM models, particularly by updating estimates of life history parameters and historical records of human-caused mortality, are planned. Additional work with the simulation tools is also envisioned; e.g., development of procedures for population risk assessment. An important objective is to incorporate population studies into the Pacific Sea Turtle Recovery Plans.

- Post-release movements and mortality

  Various patterns of post-release movement have been observed in 13 turtles carrying satellite transmitters. On average, the reception of transmitter signals has stopped about 3 months after release. Termination of signals could be caused by mortality of the turtle, exhaustion of the transmitter battery, or other factors. Improved transmitters are now being deployed that provide secondary signals indicating battery strength. Data from these transmitters should provide more reliable information about turtle survival. Notwithstanding uncertainties about transmitter life, several turtles tracked to date, including some with a hook deeply ingested, traveled several thousand kilometers, apparently against prevailing surface currents, before transmitter signal reception ceased.

- Genetic sampling

  Fifty-six percent of the turtles taken by Hawaii longliners are loggerheads. mtDNA analysis indicates that 96% of these are from nesting beaches in Japan, the remainder of Australian origin (Fig. 5). Olive ridleys, leatherbacks, and green turtles taken in the Hawaii fishery appear to come from nesting in both eastern and western areas of the Pacific.

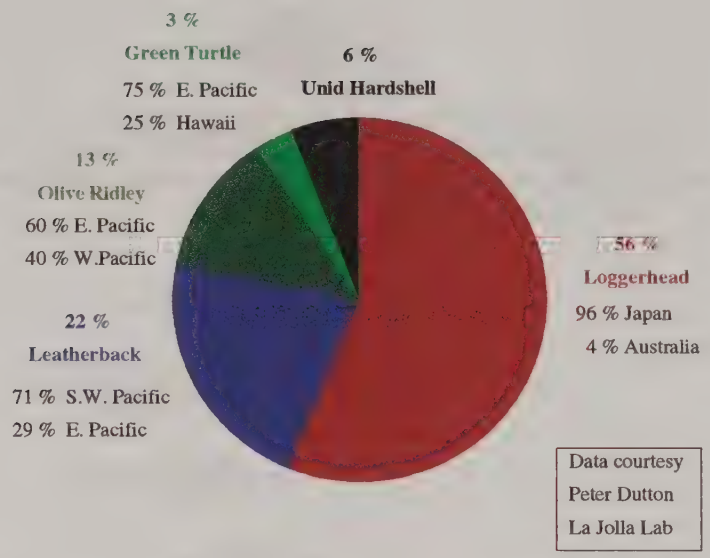


Figure 5. Species composition and natal origins of turtle takes.

***Plans**–In FY 1999 we will continue the basic research on turtle take and mortality estimation, factors determining high likelihood of incidental takes, turtle population dynamics, and impact assessment. Extensions of this research will include the following:*

- *Development of Bayesian procedures for estimation of take and mortality levels to fully exploit prior information.*

- *Development of environmental indices or pelagic habitat descriptors (from SST, TOPEX, and ocean color databases) that can be used to classify longline fishing operations (sets) as to their likelihood of taking loggerheads or other turtle species, and inclusion of these habitat variates as predictors in the regression-tree models.*

- *Evaluation of the uncertainties in turtle population impact assessments and exploration of appropriately risk-averse recovery management strategies.*

Resources

- *FY 1998*

  One-half staff-year (JIMAR computer programmer) funded by RPS to help develop TURTSIM. Replacement now being recruited. RPS funding for collaboration with Mexican turtle biologist (leatherback population modeling), annual estimation of turtle takes and take statistics workshop. One staff-year of NMFS labor.

- *FY 1999*

  Continued RPS funding will be sought for take estimation and related statistical support of the Biological Opinion, including elaboration of regression-tree models to develop take reduction strategies. Expect 2 staff-years of JIMAR labor, 1 staff-year of NMFS labor.

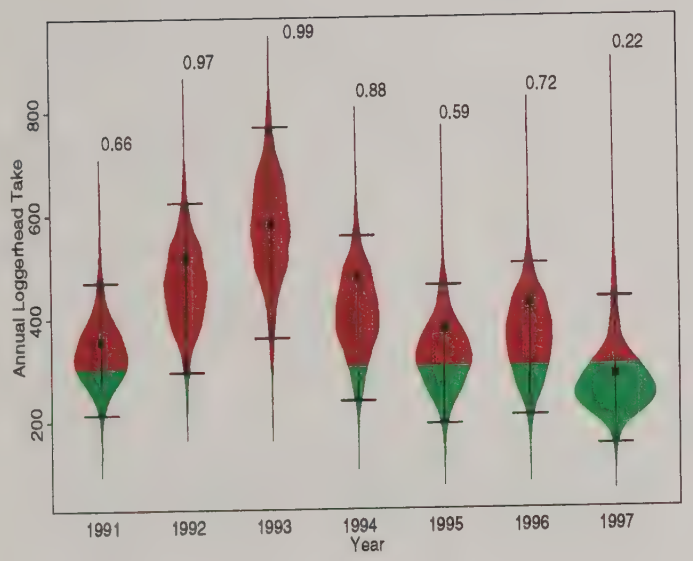


Figure 1. Take estimates for loggerhead turtles. Point estimates with 95% confidence bounds superimposed on distributions of bootstrap estimates. The number above each distribution plot is the proportion of the distribution above the allowed level of loggerhead takes - the red portion of the distribution.

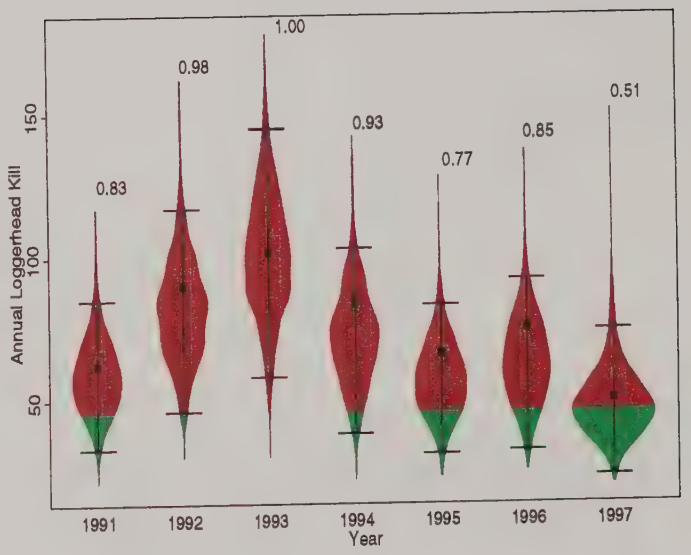


Figure 2. Kill estimates for loggerhead turtles. Point estimates with 95% confidence bounds superimposed on distributions of bootstrap estimates. The number above each distribution plot is the proportion of the distribution above the allowed level of loggerhead kills - the red portion of the distribution.

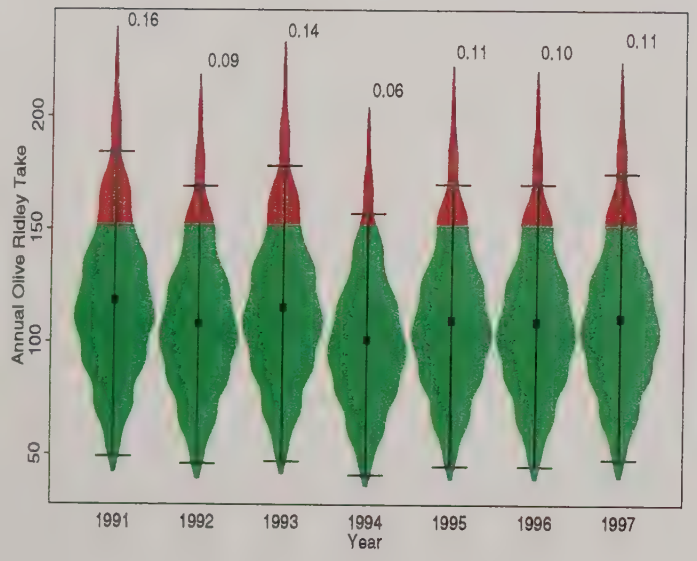


Figure 3. Take estimates for olive ridley turtles. Point estimates with 95% confidence bounds superimposed on distributions of bootstrap estimates. The number above each distribution plot is the proportion of the distribution above the allowed level of olive ridley takes - the red portion of the distribution.

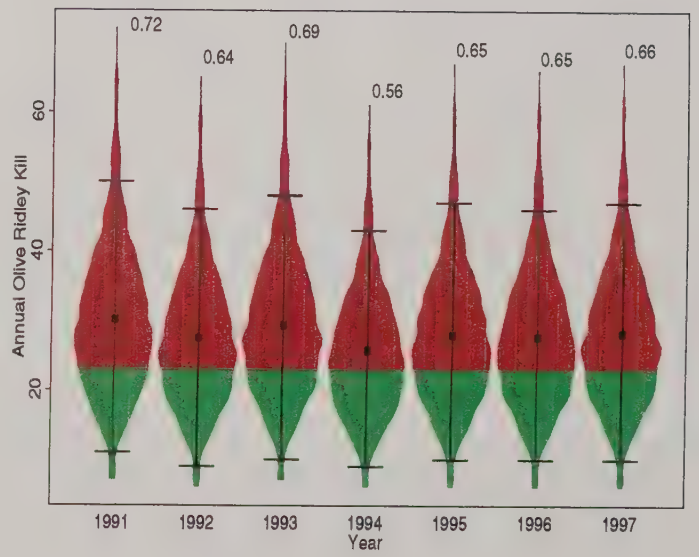


Figure 4. Kill estimates for olive ridley turtles. Point estimates with 95% confidence bounds superimposed on distributions of bootstrap estimates. The number above each distribution plot is the proportion of the distribution above the allowed level of olive ridley kills - the red portion of the distribution.

Interactions of Hawaii Longline Fishery With Seabirds

Background Information–The Hawaii longline fishery, which is directed for swordfish and tunas, has interactions with seabirds, mainly Laysan and black-footed albatrosses. In recent years, the annual fleet-wide fishery induced mortality has been estimated to be approximately 625-2,436 and 1,189-2,594 for Laysan and black-footed albatrosses, respectively. The highly endangered short-tailed albatross has been sighted in the region where the longline fishery operates, but no takes have been recorded. The WPRFMC and NMFS are under pressure from various NGOs to issue regulations requiring the use of various mitigation measures. The U.S. Fish and Wildlife Service (FWS) has primary responsibility for dealing with seabirds under the Migratory Bird Act, but NMFS shares some responsibility because it is involved in the management of the Hawaii longline fishery and because it houses relevant database for estimating seabird takes.

Laboratory Actions in Response to the Issue–The Honolulu Laboratory makes estimates of annual albatross takes and kills based on SWR observer data. These estimates have been made for the years 1994-97 and have been provided to the FWS. The Laboratory recently received funding to conduct research to reduce the mortality of seabirds caused by the Hawaii longline fishery. Most of the research will be conducted cooperatively with FWS. It will include refinement of statistical methods for making fleet-wide estimates of seabird mortality and evaluation of fishing factors related to seabird mortality using logbook records kept by NMFS observers and by fishermen. In addition, experiments will be conducted on research vessel cruises to investigate and evaluate methods and procedures for reducing seabird mortality during longline fishing operations.

Approach

- Conduct research on statistical methods for estimating seabird mortality caused by longline fishing.

- Assess impacts of the Hawaii longline fishery and other factors, including environmental variability and ecosystem changes, on seabird abundance and status.

- Evaluate potential seabird mortality reduction and mitigation strategies.

- Conduct a dedicated research cruise on the NOAA *ship Townsend Cromwell* to document longline interactions with seabirds and mitigation methods. Current efforts to document the interactions of seabirds with pelagic longline fishing gear focus on observations of real fishing operations. The number of seabird interactions in these operations is relatively low, limiting the statistical power of such observations for the purpose of determining the efficacy of various mitigation technologies such as the bird pole or subsurface deployment of the longline. A larger sample of seabird interactions could be observed by conducting experiments in close proximity to the seabird colonies in the NWHI using modified longline fishing gear where the hooks are replaced with loops to hold the bait. Bait loops would be weighted to have similar sinking properties as the hooks they replace The modified gear could be struck, bitten, or even

swallowed without seriously injuring seals or seabirds taking the bait. Bait loops have been documented in swordfish research to be effective at holding baits through a full operation.

- Evaluation of the "bird pole" for mitigating seabird mortality during up to six research cruises aboard *the Townsend Cromwell* when longline fishing research operations are conducted. The use of a bird pole has been demonstrated to be an effective measure for reducing seabird mortality in pelagic longline fisheries conducted in the South Pacific. However, similar evaluation studies need to be done in the region fished by the Hawaii longline fishery.

Results

- Estimates of seabird take and mortality have been made for the years 1994 - 1997 and provided to the USFWS.

- Data on seabirds takes and related data have been summarized and provided to FWS and WPRFMC contractors.

- Preliminary plans prepared for expanded Laboratory research on seabird mitigation.

Plans

- A 26-day research cruise will be conducted in February 1999 to observe seabird interactions with the modified (harmless) longline gear. Hundreds of interactions are expected in the vicinity of the bird colonies, providing many degrees of freedom for the statistical analysis of numerous factors. The control treatment will be to mimic normal commercial fishing operations as close as possible. The effects of diel differences in interaction rates will be measured within the control treatments which will involve setting before, during, and after sunrise and hauling before, during, and after sunset. Various mitigation treatments including the bird pole, coloring of bait, subsurface setting, and weighting the line will be conducted in contrast to the control (normal) fishing method. Detailed observations of the behaviors of birds interacting with the gear will be made. A towed underwater camera sled and diver and a small boat trailing the research vessel during sets will be used to document the depths to which birds dive to take sinking baits, whether the baits are struck or swallowed, and to make positive identifications of bird species.

- Conduct research on improved statistical methods for estimating seabird mortality caused by longline fishing.

- Continue to investigate cooperatively with FWS possible factors affecting longline fishing interactions with seabirds.

Resources

- FY 1998

  0.5 NMFS labor; bird-pole observations made on two research cruises.

- FY 1999

  1.5 NMFS staff-years; 2+ staff years UH/JIMAR labor funded by NMFS; 26-day dedicated research vessel cruise and bird-pole observations made on NOAA ship *Townsend Cromwell.*

Accessibility of Fisheries and Related Data to Users

Oracle Database, Website, and Geographic Information System

Background–Data management developed at the Honolulu Laboratory during the era of exploratory fishing and research cruises. Central management of the data was established, and documentation standards were developed. Most of the data being managed were cruise-related biological and oceanographic data. The Laboratory's goals have changed over time and are now to provide scientific information and advice for management of domestic fisheries in the U.S. EEZ, for support of U.S. interests in international management of Pacific highly migratory species, and for the recovery and management of protected species. As a consequence, the mix of data has changed dramatically, with fishery (consisting of biological, economic and social components), satellite-derived environmental, and cruise and other ecosystem data becoming dominant. Improvements have been made in the computer hardware used, and data management and distribution procedures are now undergoing a complete change.

Effective management of fishery resources is critical for the U.S. and is becoming more complex. The Laboratory is increasingly under pressure to bring more and better data, as well as more types of data, to bear on fisheries and protected species research problems. In addition, it is being required to do so rapidly and in ways that are convenient and user friendly. Fishery management is being done in a partnership with the regional fishery management councils and is becoming more of a public process because of interest in protected species and ecosystem health in general. Thus, the Laboratory is under pressure to make data and data products available to not only traditional agency, fishery management, and industry clients, but to other interested parties as well; for instance, NGOs.

The Laboratory is obligated by federal law to make data available to the general public, to register the data, and to have descriptive meta data facilitating utilization of the data. The NMFS principle approved in 1997 by the National Information Management Board is that "Data is an Agency asset and will be disseminated and protected in accordance with Agency guidelines and does not belong to any particular unit or individual." NOAA has also indicated that NMFS must demonstrate its willingness to load data and have it accessible via the worldwide web. This approach is challenging because much of the Laboratory's fishery data are confidential and will require the development of protocols for aggregating or filtering data to safeguard their confidentiality. Another serious challenge is the need for proper and effective security measures.

Response to the Issues--To address the issues noted, the Honolulu Laboratory has adopted an interrelated three-prong strategy that includes:

- Adopting Oracle as the Laboratory standard database management system.
- Using the worldwide web as a means for users to browse data holdings and to obtain electronic data as well as standard and specialized data products.

- Implementing a Geographic Information System (GIS) for use in displaying, analyzing, and interpreting data and data products and their relationships.

Approach–An Oracle Conversion Team with several working groups and made up of staff from various Laboratory investigations was set up to develop a centralized, online database using Oracle.

- A Data Working Group within the Swordfish Research Team has been established to address data catalog, documentation, data flow, and data handling issues on a Laboratory-wide basis.

- A developer-coordinator position has been established to provide guidance, oversight, and coordination for the development of a Laboratory Internet web site.

- A position was established to head up the development of geographical information system (GIS) capabilities at the Laboratory.

- The Oracle database system development, web site development and operation, and GIS technology have been aligned into a high technology group within the Laboratory's ITS Investigation.

Results

- With initial assistance from a contractor, a Laboratory Oracle Conversion Team has developed an 'enterprise' model for managing the Laboratory's diverse databases and data holdings. The model has been tested, modified as needed, and evaluated. Several types of data have been loaded into the model for testing and have been successfully retrieved in a variety of report formats. At this point the model is functioning with increasing success as staff members become more comfortable with it and are trained in the proper procedures and methods.

- Several data sets have been loaded into the Oracle system including: Western Pacific Pelagic Longline Logbook for 1991-97, SWR's Western Pacific Longline Observer for 1993-97, Lobster Logbook and lobster observer for 1997, and virtually all Hawaiian monk seal field camp data for 1982-97. In addition, Hawaiian green sea turtle data previously maintained in "xbase" have been converted to Microsoft Access, and several sea turtle data sets have been converted into the enterprise model from the Access database.

- The Oracle Hawaiian monk seal database is fully functional and is being used for validation of field-entered data and routine preparation of reports.

- An Enterprise Model Working Group has been formed to continue improving the model to make it easier to use; e.g., redesign of tables to facilitate automated loading of data sets and more routine extraction of data, to develop applications

for preparing routine reports, to provide training to Laboratory staff, and related actions. Loading of data sets into the enterprise model will continue.

- Several fisheries data sets, including WPacFIN, which are needed for various reports; e.g., fisheries modules for the WPRFMC annual report, are being loaded into a simplified table structure in Oracle and are used to produce analyses outside the Oracle enterprise model. This approach will diminish as procedures for more rapidly loading data into the enterprise model by the Fishery Data Management Program and applications for extracting data and products are developed.

- A special Data Working Group has been established within the Swordfish Research Team to prepare a plan for the development of a catalog of swordfish data sets, documentation of data collection protocols and sample designs, and documentation of data flow and handling procedures which will be incorporated into the Oracle database system as metadata.

- Several Laboratory web sites have been prepared and are available on a Laboratory intranet to selected users for testing and evaluating. These web sites include over 5,000 pages for WPacFIN. Other web sites include island fishery agency information, fishery monitoring data, and general information about the Honolulu Laboratory and fishery oceanography. The CoastWatch Site is a popular web site for registered users to browse satellite images, to obtain digital data files of HPRT/AVHRR sea surface temperature data and products, to view SeaWiFS ocean color and satellite-altimetry-derived ocean circulation products, and to obtain oceanic satellite remote sensing related information.

- The Laboratory has recently hired through UH/JIMAR a web site specialist with several years experience in preparing and managing web sites for the multi-state, multi-disciplinary Chesapeake Bay Program. He will coordinate all of the web site activities at the Laboratory and play a key role in putting data on to the web site(s) for access by users.

- The Laboratory also just hired through UH/JIMAR a Ph.D. level GIS expert who will be responsible for developing GIS capabilities at the Laboratory.

Plans for FY 1999

- Develop enterprise model, load data sets, and develop report and summarization applications.

- Load data sets into the flat file (actually simple/header-detail) schema.

- Register data sets, with descriptive metadata.

- Document data flow and handling procedures.

- *Provide access to Laboratory data and data products by Laboratory users via an intranet and outside users via the Internet*

- *Address security issues relative to Internet access to our computer systems and enterprise database.*

- *Develop a GIS database of coverages, applications for Laboratory users, and GIS products for delivery via our intranet and the Internet.*

Resources

- *FMPI*

  One FMPI programmer 50%
  One FDMP programmer 20%
  One FDMP Research Analyst 25%
  One FDMP JIMAR Computer Clerk 25%

- *ITS*

  One Supv Fishery Biologist 100%
  One Systems Analyst 15%
  One WWW JIMAR programmer 100%
  Two GIS JIMAR programmers 100%
  One Oracle DBA 80%
  One Network Administrator 40%
  One UNIX Administrator 15%

- *PSI*

  Two PSI JIMAR programmers

Issues

- *Continued funding of the JIMAR personnel.*

- *Continued FIT Funding for the existing IT-95 hardware, software, and maintenance as well as additional funding to permit the gradual replacement of existing equipment and the procurement of additional hardware and software required.*

Fishery Monitoring

Fisheries monitoring is critical for providing scientific advice to meet the Laboratory's mission. These operations involve three programs: fisheries statistics obtained from Federal logbooks and shoreside monitoring of the Hawaii-based longline and lobster fisheries; a similar program for the American Samoa longline fishery; and the Western Pacific Fishery Information Network which compiles state and territorial fisheries agency data. The fisheries monitoring operations generally operate smoothly and successfully. However, there are issues and needs facing this program which need attention and additional resources, including: 1) limited sampling at the Hawaii fish markets, 2) need for improved coordination of the NMFS longline observer data records with concurrent longline logbook records, 3) inability to validate Hawaiian longline fishery logbook records, and 4) incomplete collection of American Samoan longline federal logbooks. Each of these will be discussed separately.

Background Information–Conducting fisheries research is highly dependent on ready access to quality data. This involves the identification of data needs and ensuring that these data are collected and made available to the appropriate researchers. To accomplish this, data can be acquired from or made available by linking to outside sources or can be collected directly by the Honolulu Laboratory. Regarding the latter, it is important to ensure that the quality and quantity of the data meet statistical requirements. The present market sampling program has been conducted at the Honolulu auction since 1984. The Honolulu auction is the largest public auction for fish and seafood products in Hawaii. It is the central focus of nearly all of the sales activity of the Hawaii longline fleet and the Northwestern Hawaiian islands bottomfish fleet, both of which fall under federal management. The landings and sales information gathered provides the baseline for monitoring and assessing two of the four FMP fisheries–Pelagics and Bottomfish. The market monitoring frequency has decreased over the years (Fig. 1) as demands on Fishery Management and Economics Program (FMEP) personnel have increased due to mandated logbook programs and other priorities. A rigorous evaluation of the auction sampling program has never been completed.

NOAA's strategic goal to build sustainable fisheries has resulted in research priorities to investigate the statistical basis of Laboratory data collection activities. Management and its requisite data requirements are foreseen to multiply as the Honolulu Laboratory and the WPRFMC are tasked with highly migratory species (HMS) responsibilities. Stock and resource issues concerning pelagic management unit species (PMUS) have brought up the question of adequacy of the sampling program. For instance: Are we getting enough data? How much more do we need? How much will the data improve if we add an additional day? 2 days?

Additional sampling needs outside of the present market monitoring program include collection of NWHI post-harvest lobster size frequencies (both frozen tail and whole live), bottomfish size frequency and landings data from others in the MHI (bottomfish management) and local troll and handline size frequency and landings data of PMUS (Pelagic FMP issues). As the Laboratory becomes more involved in research on HMS it is likely that additional new sampling programs will be required.

Approach

- Sample the Honolulu auction 2 working days per week. The workload is shared with the State of Hawaii's Division of Aquatic Resources (HDAR) and FMEP. All data to the NMFS (FMEP/FDMP) for coding, editing, entry, and report generation.

- Determine the adequacy of the existing sampling design. Does the auction sample provide a representative picture of the managed stocks? How much more sampling needs to be done to produce a representative sample; i.e. additional day(s), effects of different days on species specific data, effects of sales strategies (multiple day unloading), representativeness of the data with respect to outer island stocks, etc.

- Preliminary analyses suggest that a minimum of three sampling days would be required to get a representative picture of the swordfish landings (DiNardo, personal communication).

- When necessary, limited lobster and bottomfish sampling has been conducted without dedicated personnel or funding.

Results

- At this time auction market sampling is adequate for the present NWHI bottomfish data requirements but does not provide a representative sample for MHI bottomfish requirements. Future data requirements will require additional resources.

- Preliminary evaluation of lobster shoreside sampling program suggests that the present sampling effort is not sufficient to provide requisite data.

- The representativeness of the Honolulu auction data under the present sampling program is unknown. Honolulu market data concerning imported FMP species both HMS and BMUS are limited.

Plans

- Continue market sampling program at present low level to fulfill NWHI bottomfish FMP data needs. Future data requirements will need to be evaluated and will require additional resources.

- Continue to gather biological and economic information on the MHI bottomfish and non-longline pelagic stocks at the Honolulu market.

- Continue market sampling program to gather biological and economic information on the landings of the Hawaii longline fleet.

- Evaluate data collection procedures and implement necessary modifications, the result of which would be statistically based sampling designs capable of delivering the required quality and quantity of data.

- Hire additional personnel to assist in data collection. Personnel would be responsible for collecting a variety of biological and market data as well as for coding and editing duties.

Resources

- Present staff resources of FMEP (NMFS) and FDMP (NMFS/JIMAR) are already inadequate to meet the data monitoring and collection demands for local and other fisheries issues. Additional personnel are needed. Future demands will increase as the Laboratory is tasked with management of highly migratory species, in both the domestic and international arena.

- Staffing must increase as data requirements and demands increase.

Need for Improved Coordination and Quality Control of Observer and Hawaii Longline Logbook Data

Background Information–A sampling of Hawaii longline fishing trips carry scientific observers on board as part of the Southwest Region (SWR)'s sea turtle observer program. For these trips there are two sources of data pertaining to at-sea fishing operations and the resultant catch of both target and nontarget species: mandatory logbooks kept by fishermen and data recorded by the observers. For some types of analyses, it is useful to cross-reference the two data bases on a set-by-set level. Cross-referencing between the observer and logbook data has been established by hands-on examination of original logbook data sheets to make educated guesses as to which observer set corresponds to which logbook set.

Attempts to make such a connection have revealed various problems in both data sets. Dates, times, and locations of sets do not always match, and in some cases the two data sets do not even agree on the number of sets made in a trip. The errors which occur in set-specific information such as dates, times, and locations lead in turn to discrepancies between the two data bases and also within each of the data bases. Prior to 1998 there has been no unambiguous set identifier included in the logbook data, and the observer program protocol has not included the recording of reliable cross-referencing information. Therefore, the only information available for cross-referencing the observer and logbook data (before 1998) is the error-prone, set-specific information. An improved method to automatically cross-reference the two data bases would be highly desirable.

Although set-by-set links between the observer and logbook data have been made, and may be more efficiently made in the future, the discrepancies in set specific information remain in spite of current data checking procedures. Many discrepancies are minor and inconsequential for some analyses but these uncertainties can limit the usefulness of the data for other types of analysis. For example, soak times might be useful as a component of fishing effort, but confusions in set and haul dates and times make calculation of soak

times very unreliable. To further minimize errors in the data bases, it would be possible to improve the data checking procedures, particularly for observed trips, by striving to resolve discrepancies shortly after the data are collected.

Laboratory Actions in Response to the Issue--Following discussions between Fisheries Management and Economics Program (FMEP) and Fisheries Data Management Program(FDMP) personnel and Honolulu Laboratory researchers, some actions have been taken to facilitate the cross-referencing of logbook and observer data in the future and to enhance the quality of the data.

From January 1998, logbook computer files have been augmented with a new field containing the unique logbook page sequence number that is preprinted on logbook sheets. That sequence number provides an unambiguous identifier for each longline set in the logbook data. Complementing this is a request to the SW R to have observers record the logbook sequence number on all of their forms and have it incorporated into the observer data base.

Results

- Cross-referencing of logbook and observer data has been accomplished for the period 1994 through 1997 without the benefit of logbook sequence numbers. Although the process was laborious, time consuming, and at times confusing, it provided some insight into the sources of common errors in the set data. Many of the problems result from confusion of set dates and times with haul dates and times, and other problems seem to result from confusion of dates when fishing operations are begun shortly before or shortly after midnight.

- It was discussed that striving to resolve discrepancies shortly after the data are collected would further minimize errors in the data bases.

- It was decided to incorporate the unique log sheet serial number into the Hawaii longline database.

Plans--To provide improved data quality checks it is proposed to:

- Request NMFS SWR observer program to incorporate recording of the unique logbook sequence number on all data sheets.

- Designate a person familiar with the operational aspects of the fishery to act as a Quality Control Monitor (QCM) to

- Facilitate and coordinate the receipt of the observer data and identify the corresponding logbook trip records.

- Cross-check and validate the information on a set by set basis, including interviews with vessel captains and observers.

- Pay particular attention to the sorts of confusions mentioned above.

- Improve the data processing stream so that cross-checking and other quality control operations can be conducted as soon as possible following the end of each fishing trip.

- Facilitate the process of incorporating corrections into the data bases.

- Provide FMEP with a list of corrections, additions, or changes to the longline logbook data base.

- Maintain master copy of the data bases on Oracle so that the most up-to-date data are available at all times to analysts and other data users.

- Recommend that observer data be entered directly into Oracle data base by the observer in Hawaii. The Honolulu Laboratory will prepare all data entry formats and scripts, promote training, and initially assist in oversight .

Resources

- FY 1998 - Status quo.

- FY 1999 - Quality Control monitor: JIMAR labor.

Experiment to Evaluate the Use of Vessel Monitoring System (VMS) Data for Validating Longline Logbook Records

Background Information–The Vessel Monitoring System (VMS) is a valuable tool in the management of Hawaii's federally managed pelagic longline and NWHI lobster fisheries. Its use has enabled the longline fishery's closed area regulations in the MHI (gear conflict concerns) and the NWHI (protected species concerns) to be administered in a timely and cost-effective manner by the U.S. Coast Guard and NMFS SWR Enforcement. The use of VMS by Enforcement has resulted in increased awareness and compliance of the FMP regulations by the fleet. More recently, its use in the NWHI lobster fishery has enabled the fishermen to be more economically efficient by saving transit time and fuel expenses associated with regulated fishing areas and open and closed season prohibitions in the derby fishing format.

The information derived from the longline logbook is critical to the management of the pelagic fisheries. Since the inception of the longline logbook program in 1989 there have been questions as to the accuracy of the data, especially of the reported fishing locations. At this time, logbook fishing location verification is not possible. The only exception is that closed area fishing violations warrant an official investigation. In some of the violations it was found that the vessel operators were either unaware of their actual fishing location or had inaccurately plotted and logged the location.

The VMS program, which has been in place since 1994 (59 FR 58789; Nov. 15, 1994), can now provide answers to the questions concerning logbook positions. The onboard VMS unit is activated throughout the fishing trip and sends individual vessel

positions at predetermined intervals to a base station. This information can be linked to logbook positions.

Laboratory Actions in Response to the Issue–In pursuit of the National Oceanographic and Aeronautic Administration (NOAA) Fisheries strategic goal to build sustainable fisheries it is essential to the fishermen and the fishery that managers and researchers have the most accurate data possible to strengthen assessments and to have confidence in management decisions. Towards this end it is essential that the Honolulu Laboratory and NMFS take steps to provide the best data possible. Accurate catch and effort data provide the baseline for successful and responsible proactive fishery management which includes the reduction or possible prevention of takes of protected species while maintaining the efficiency of the fleet.

Approach--At this time, validation of the fishing locations is not possible. Therefore, logbook editing consists of range-based checks on data fields where possible.

- Use existing error checking by the longline check system (LLCS) program to flag out-of-range locations. Data check and correction through contact with vessel captain or owner. Realities are that the locations subsequently provided to FMEP staff through dockside interviews with captains-owners are many times not available or are "guesstimates" due to the high turnover of vessel captains or the extended time interval between the problem identification (by FMEP or other researchers) to the time of the inquiry. Corrections are made by the captains/owners to be legal (avoid fines) and may not have anything to do with the accuracy.

- Use the error lists from researchers involved in using the logbook data set; i.e., research comparing the large longline data set to the minimal amount of observer data available (<=5% of total longline trips). Corrections are conducted in the same manner as those for LLCS.

Results

- Presently, FMEP's LLCS error check program routinely flags out-of-range distances. The most common error found is from distance calculations between the recorded set and haul locations from a single set. The errors in the distance between the set and haul vary widely and range from >65 nmi to >1,200 nmi. Other distance-location errors are from between sets where the distances are farther than can be navigated by the vessels in the time period between a haul and the next set. These errors fall within the same magnitudes.

- LLCS initial error checks flag location errors, many of which reflect errors of large magnitudes. Locations in excess of 1,200 nmi have been flagged. More commonly the errors are within the 200-500 nmi range.

- Observer coverage of the longline fleet is estimated to be approximately 5%. Preliminary comparisons of this limited amount of observer data with corresponding logbook data indicate that there is a problem with locations,

dates, and times of the sets. The magnitude of the problem is presently unknown.

- Independent research comparisons between the observer data set and the logbook data sets also indicate a number of instances where an observer records a set(s) while the complementary log sheets do not record any fishing activity at all. When the fishing locations, times, and dates that are recorded by observers are compared to logbook data recorded by the captain, comparable data elements do not always match, and there is an alarming number of discrepancies that merit error status.

- At this time the extent of the inaccuracies in the logbook database is unknown. Indications from the existing error-checking program show that the use of a subset of longline VMS data to ascertain the accuracy of the logged data elements is warranted.

Plans/Options

- Status quo: Continue to use existing systems to produce the most accurate information possible.

- Request a subset of the VMS data to run preliminary estimates on the accuracy of vessel location information from the mandatory FMP longline logbook program. The requested data set should not be from the present fishing year. A three-month subset of the VMS data should be sufficient for analytical purposes. The requested time period would be determined by analyzing the existing logbook data set to get the most representative information from the results.

Resources

- **FY 1998**

  The FMPI of the Honolulu Laboratory is wholly involved with monitoring the FMP fisheries. At this time all coding, data entry, editing, and primary report generation (Quarterly Reports, Annual Reports) are handled in-house by FMEP, FDMP, and WPacFIN personnel. Data and special requests are handled by FMEP personnel.

- **FY 1999**

  Cross-checking a subset of the VMS data will initially require additional programming time of 1 programmer @ 1 year. The final program could be incorporated into the LLCS system or remain as a stand-alone to provide an additional report on an annual or semiannual basis.

American Samoa Longline Logbook Program

Background Information--The rapidly growing American Samoa domestic longline fishery began in mid-1995 with 4 boats and has since grown to 22 boats in 1997. The fleet is composed predominantly of alias which are 30-ft twin hulled boats powered by two small gas-powered outboard engines. In 1997 several large locally owned vessels in excess of 50 feet entered the fishery. The fishing gear used is comparable to that used in Hawaii but on a much smaller scale, fishing an average of 200-300 hooks per set on 3-5 nmi of main line. The setting and hauling equipment is low tech (manual/hand operated) for the alia fleet which has no hydraulic capabilities. The setting operation typically begins in the morning, and the hauling begins around noon. Most boats use little or no ice and the catch is stored in the hull of the boat . After the fish are landed the albacore are frozen and stored for later sale to the canneries. Other catches are sold to stores, restaurants, and the local population, or are given away.

The WPRFMC has federal management responsibilities for this fishery. American Samoan longline vessel owners are required to have valid general western Pacific longline permits and to maintain a federal western Pacific daily fishing longline logbook. Estimated albacore landings rose from about 50,000 pounds in 1995 to an estimated 630,000 pounds in 1997. The rapid growth of the fishery caused large concerns within the local fishing community over rumors of large vessels from outside American Samoa coming to exploit the unrestricted fishery. In response, the WPRFMC passed a control date in November 1997 as a precautionary management measure while assessing the data before deciding on the proper management design. The WPRFMC is currently developing an area closure-restriction form of management for the nearshore waters around American Samoa.

Successful management for sustainability requires close monitoring of the fishery. The American Samoan longline fishery monitoring program's structure is not consistent with proper quality control and efficiency requirements. The program must be streamlined and updated to yield the data necessary to properly assess and manage the resource. Presently the monitoring activities are conducted by four different entities: 1) fishermen-owners submit the logbooks to American Samoa's Division of Marine and Wildlife Resources (DMWR) enforcement personnel or to SWR enforcement; 2) logs are then transferred to SWR PIAO personnel in Pago Pago for some preliminary edit checks before mailing to PIAO in Honolulu; 3) PIAO then routes the logs to the Honolulu Laboratory's FMEP which checks and codes the logs; 4) if clarification or more information is needed, the logs are rerouted to PIAO in American Samoa for inquiry at the fishermen-owner level (as many times as needed); 5) edited logs are returned to FDMP in Honolulu for data entry. These preliminary data are checked by a minimal error program, which is not as extensive as that used for checking the Hawaii longline data, before the data are used for summary reports.

Although the logbook data are self reported and most data elements are generally unverifiable, some logbook information has shown improvement when compared to creel survey estimates by WPacFIN, DMWR. Preliminary results (Table 1) from this comparison show that logbook catch and effort data are still being under reported. The under reporting may be caused by nonreporting of the logbook trips, incomplete accounting of catch, incorrect species identification, etc. The logbook program in American Samoa must be

reassessed and refined to minimize the degree of under reporting and the fishermen must be educated to improve their reporting and species identification skills.

Laboratory Actions in Response to the Issue–The Honolulu Laboratory Fishery Monitoring and Economics Program (FMEP) supports the NOAA Fisheries' strategic goal to "build sustainable resources" by providing logbook summaries in a timely manner, by providing summary and raw data to other Laboratory programs, and by fulfilling WPRFMC information requests. Quarterly and annual reports on the American Samoa longline fishery are disseminated to the WPRFMC, SWR, SWR enforcement, other research organizations, and the public.

The added responsibilities of the American Samoan longline fishery has overextended the resources of the FMEP and FMPI programs. The logistics of monitoring this fishery is inefficient for quality control procedures and timely dissemination of information.

Approach–Continue current monitoring activities which include the following:

In American Samoa:

- Collection and transfer of data from the SWR field office in American Samoa to the Honolulu Laboratory.
- Editing of raw data prior to data entry.
- Data entry and verification of raw data.
- Creating and maintaining computer programs to validate "reasonable" values for each data field.

In Honolulu:

- Archiving and storing data.
- Completing quarterly and annual logbook reports in a timely manner.
- Assisting fishery managers and biologists by providing specific information while maintaining confidentiality of the data.

Use the best available logbook data to prepare quarterly and annual reports to monitor the number of vessels, days fished, hooks set, total catch (number of fish), and CPUE (fish per 1000 hooks).

Continue to use WPacFIN/DMWR creel survey to monitor and verify the logbook data.

Propose expansion of data collection and monitoring activities in American Samoa to include:

- Non-enforcement data collectors.

- Onsite editing, data input, and report generation (to eliminate the mailing time and produce more accurate input).

Results

- Logbook summaries indicate that the fishery continues to expand. Vessels, effort, CPUE, and landings have increased dramatically since the start of the fishery (Fig.1-7).

- Comparison of the creel survey estimates and the logbook data indicates that the logbook data are incomplete (Table 1).

- The logistics of monitoring the American Samoa longline logbook program from Hawaii are inefficient and time consuming.

Plans

- Continue to investigate the quality of the data on a finer level (boat by day).

- Include the American Samoa quarterly and annual reports on the Honolulu Laboratory web site.

- HL to cooperate with SWR PIAO (American Samoa/Honolulu office), DMWR, and WPacFIN to eliminate the role of enforcement personnel in the collection of logs.

- Streamline the data collection and editing process taking into account the quality control advantages of onsite editing, data entry, and monitoring activities.

- Dedicated resources are required to collect and provide primary quality control of American Samoa longline logbook programs.

Resources

FY 1998

- Although no funds were specifically designated to support the monitoring or development of the American Samoa longline logbook program, the Honolulu Laboratory's FMEP, WPacFIN, and FDMP have dedicated a considerable amount of limited resources to monitor the developing fishery.

- It is estimated that FMPI will expend 1.25 staff years to maintain the status quo of editing, data entry, and quarterly and annual report generation. Additional time will be needed for special data requests and analyses.

- Additional resources are needed to maintain and improve the current level of monitoring effort. It is anticipated that the level of participation in the fishery will continue to increase both in numbers of participants and in the level of effort and landings. Time and effort by FMPI personnel will increase to keep up with the volume of logbooks. One programmer @ 1 year will be needed to create an edit and range check system for the data. Presently the error checking program is nowhere near the level of sophistication of the Hawaii longline checking program.

FY 1999

- Relocation of monitoring responsibilities/activities to American Samoa (onsite) to improve efficiency and data quality will require additional resources . Additional personnel (1 staff year technician, 1 staff year programmer) and equipment (computer system) will be needed to monitor, collect, edit, error-check, and produce reports. Initial quality control and editing onsite will result in timely feedback to the fishermen on data reporting requirements and any editing that is necessary. This will result in a timely dissemination of information from which management can be more responsive to this rapidly changing fishery.

American Samoa Longline

Table 1.--Comparison of the Federal Logbook Data with the Creel Survey Estimates

Catch and Effort	Logbook total	Creel survey estimate	Percent difference
1996			
Vessels	9	13	-31
Days fished	531	1,372	-61
Billfish: Blue marlin	92	147	-37
Billfish: Swordfish	3	9	-67
Sharks	28	78	-64
Tuna: Albacore	4,028	5,818	-31
Tuna: Bigeye	132	191	-31
Tuna: Skipjack	6	63	-90
Tuna: Yellowfin	645	742	-13
Other PMUS: Mahimahi	227	219	+4
Other PMUS: Wahoo	82	90	-9
1997			
Vessels	22	22	0
Days fished	1,536	2,173	-29
Billfish: Blue marlin	225	298	-24
Billfish: Swordfish	22	4	+450
Sharks	87	95	-8
Tuna: Albacore	13,053	14,296	-9
Tuna: Bigeye	154	67	+129
Tuna: Skipjack	428	263	-63
Tuna: Yellowfin	947	1,332	-29
Other PMUS: Mahimahi	842	1,293	-35
Other PMUS: Wahoo	348	380	-8

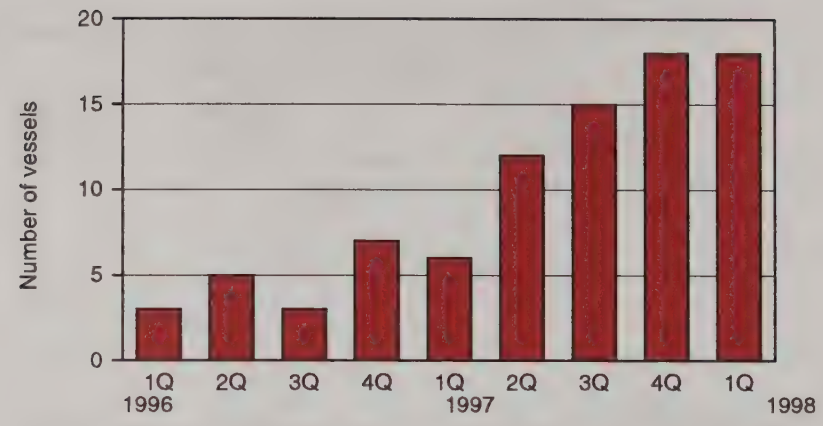


Figure 1.--Number of American Samoa longline vessels by quarter, 1996-98.

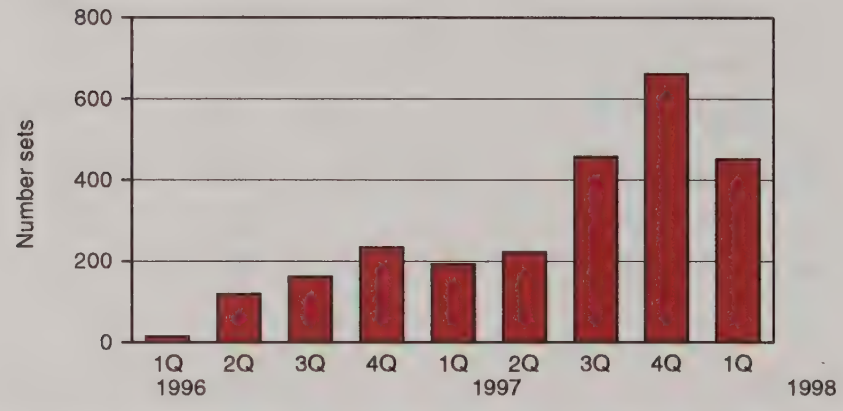


Figure 2.--Number of sets per quarter by American Samoa longline vessels, 1996-98.

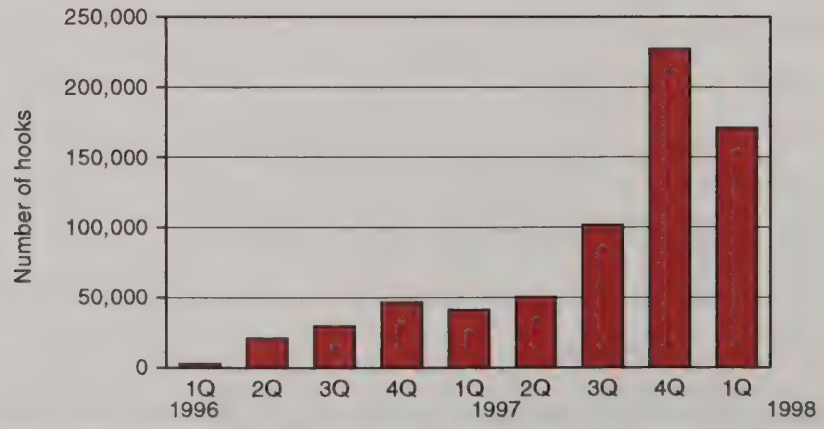
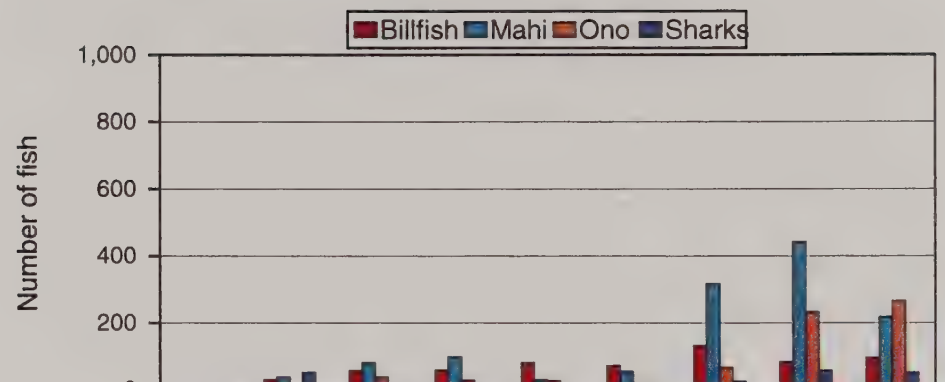
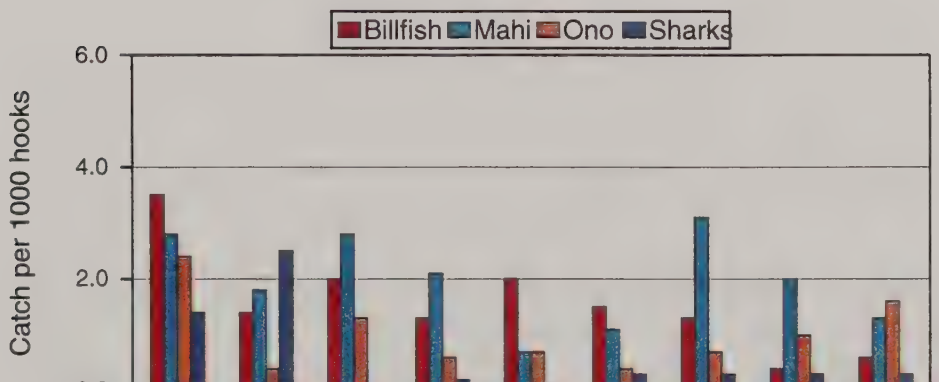


Figure 3.--Number of hooks set per quarter by American Samoa longline vessels, 1996-98.



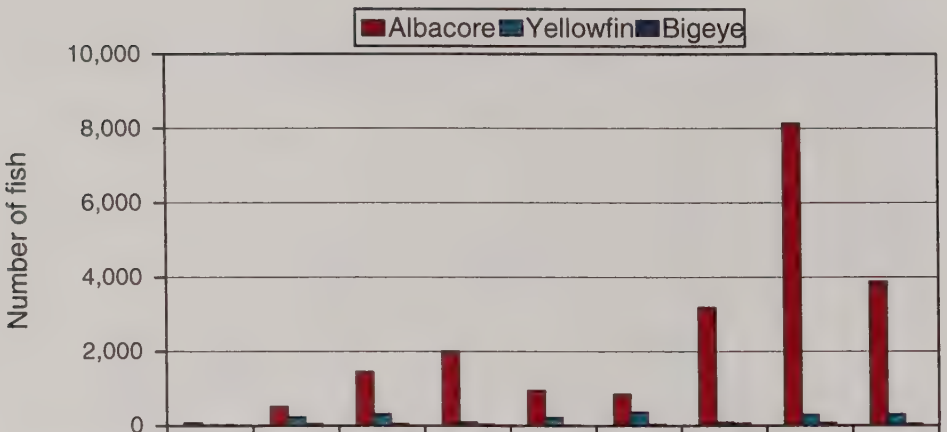
	96:1Q	96:2Q	96:3Q	96:4Q	97:1Q	97:2Q	97:3Q	97:4Q	98:1Q
Billfish	10	30	59	60	83	73	132	84	97
Mahi	8	38	82	99	30	56	316	442	218
Ono	7	8	38	29	27	20	68	233	266
Sharks	4	53	0	8	5	16	26	59	53

Figure 5.--Catch of miscellaneous pelagic species by quarter



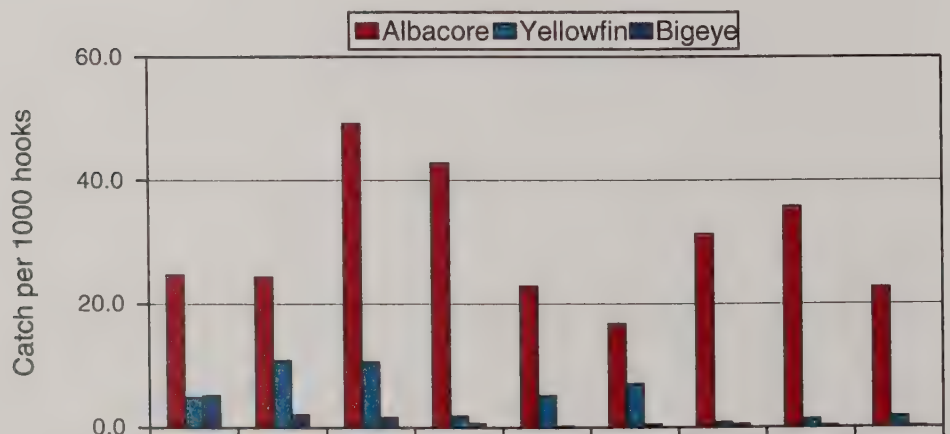
	96:1Q	96:2Q	96:3Q	96:4Q	97:1Q	97:2Q	97:3Q	97:4Q	98:1Q
Billfish	3.5	1.4	2.0	1.3	2.0	1.5	1.3	0.4	0.6
Mahi	2.8	1.8	2.8	2.1	0.7	1.1	3.1	2.0	1.3
Ono	2.4	0.4	1.3	0.6	0.7	0.4	0.7	1.0	1.6
Sharks	1.4	2.5	0.0	0.2	0.1	0.3	0.3	0.3	0.3

Figure 7.--Catch per 1000 hooks of miscellaneous pelagic species by quarter



	96:1Q	96:2Q	96:3Q	96:4Q	97:1Q	97:2Q	97:3Q	97:4Q	98:1Q
Albacore	71	510	1,450	1,997	940	846	3,182	8,130	3,876
Yellowfin	14	227	316	88	213	358	84	292	299
Bigeye	15	44	46	27	6	26	55	67	39

Figure 4.--Tuna catch per quarter



	96:1Q	96:2Q	96:3Q	96:4Q	97:1Q	97:2Q	97:3Q	97:4Q	98:1Q
Albacore	24.7	24.4	49.2	42.8	22.9	16.8	31.3	35.8	22.7
Yellowfin	4.9	10.9	10.7	1.9	5.2	7.1	0.8	1.3	1.8
Bigeye	5.2	2.1	1.6	0.6	0.2	0.5	0.5	0.3	0.2

Figure 6.--Tuna catch per 1000 hooks by quarter

Upgrading WPacFIN To Meet Today's Needs

Background--In 1981 WPacFIN was initiated as a means of focusing cooperative efforts of fisheries agencies in the central and western Pacific to improve fishery monitoring and reporting systems to better meet local and federal fishery management needs. Through the guidance of the WPacFIN Fisheries Data Coordinating Committee (FDCC), the central WPacFIN office in the Honolulu Laboratory has strived to develop and implement appropriate and comprehensive data collecting and processing systems in each of the four major WPRFMC island areas. Formalizing and standardizing data collecting systems and computerizing the collected data began in the early 1980s when WPacFIN agencies implemented new data systems and Apple II+ microcomputers using the off-the-shelf DB Master data base system and Apple BASIC. In the mid to late 1980s, all agencies converted to MS-DOS-based IBM compatible computers except the Guam Division of Aquatic and Wildlife Resources (DAWR) which stayed with Apple and moved to Macintosh computers. Central WPacFIN staff developed new menu-driven applications for each data system by using the dBASE management system and programming language. WPacFIN is now evolving toward the Windows 95/98 GUI (graphical user interface) environment in all agencies, including DAWR, and toward using the Visual version of FoxPro for the data base engine and programming.

Data collection systems are changing in each of the island agencies to improve existing fisheries monitoring programs and to begin addressing many of the increased informational needs of the local and federal fisheries management organizations within WPacFIN. In particular, plans are being developed and changes implemented to initiate projects to collect data to meet new SEA and Plan Team reporting requirements, such as bycatch, fishing sector, charter boat, and recreational fishing data. The central WPacFIN office will assist in developing these changes and must support them by developing appropriate data processing and reporting systems for the island agencies and training for local staff.

Significance–WPacFIN island agency data systems are the monitoring mainstay of many fisheries in the central and western Pacific and provide data and information for meeting many Magnuson-Stevens and Sustainable Fisheries Act requirements. It is essential to keep island agency data collecting and processing systems up-to-date to provide the ever increasingly complex and comprehensive data needed for fisheries management. Use of the Internet and development of a WPacFIN web site is improving the availability of WPacFIN data and information.

Laboratory Actions in Response to the Issue–Over the past two years, primarily in response to increased funding made available through the PacFIN data initiative, the Honolulu Laboratory and the central WPacFIN office have been able to revitalize efforts to assist island fisheries agencies develop and improve their data collecting and processing systems. By hiring new RCUH and JIMAR computer programmers dedicated to developing processing systems for island agencies, the central WPacFIN office has begun making major progress in upgrading data systems in the islands and making products more readily available through the Internet. Additional funds for upgrading hardware and software and for providing increased levels of on-site support to the island agencies are making it possible to identify specific areas needing improvement and to develop plans and mechanisms for implementing needed changes.

Approach

- Assist agencies in obtaining and implementing new technology, hardware, and software through use of all funding sources available.

- Develop new Windows-based data processing software for island agencies, install it and train local staff on its use.

- Develop new data quality control procedures for existing and new data processing systems and develop and integrate new sources of data into these systems to increase validation of fisheries information.

- Investigate possibilities for developing and implementing new data collecting mechanisms to fill information gaps on bycatch, charter boats, and recreational fisheries.

- Initiate pilot projects to investigate possibilities for implementing longer term research and monitoring programs.

Results

- Manpower resources improvements.

  In addition to existing support staff for data processing, managing, reporting, analyzing, and coordinating, central WPacFIN now has five JIMAR/RCUH computer programmers dedicated to developing software for island agencies and one dedicated to developing the WPacFIN web site.

- On-site technical support, troubleshooting, and training.

  Frequent meetings between central WPacFIN and HDAR staff are held to ensure that progress is being made on numerous cooperative projects. Additionally, by the end of this fiscal year, central WPacFIN staff will have made three on-site visits to each of the "out-island" agencies to perform a wide variety of technical support activities, including assisting with developing report modules for Council Plan Team annual reports, developing specifications for new and improved data and processing systems, investigating data quality problems and means of eliminating them, and implementing new data systems and training staff on their use. On-site visits and meetings with local agency staff are critical to making continued improvements to data collecting and processing systems.

- Hardware upgrades.

  Numerous hardware upgrades have already been implemented this year, and plans have been developed for each agency to complete the first round of upgrades to standardize he 200+Mz Pentium PC, Windows 95 environment.

- Software upgrades.

New systems have been developed and implemented for processing CNMI northern island bottomfish data and for reducing the Guam DOC vessel identification problems, and a prototype Visual FoxPro system is nearly completed for the American Samoa commercial fisheries monitoring program. About 80% of the programming for the Guam DAWR offshore creel survey system has been completed and nearly the same proportion for the first major modules of Hawaii DAR's Fisherman Reporting System. Progress has also been made on DAR's Commercial Marine Licensing System and on the design for GDOC's new tuna transshipment system.

- Web site development.

  Although the WPacFIN web site currently contains over 5,000 pages, it is still in its developmental stage, is available only to WPacFIN member agencies, has many "stubbed-in" pages, and needs many improvements. Nonetheless, it represents a major undertaking and accomplishment in laying the groundwork for on-line data and information access using the modern technology of the Internet. Once the initial design of the web site is finalized by member agencies for accessibility to the static pages of data and information, the next phase of development will be for dynamic queries against summary data bases. Only nonconfidential data will be available through the Internet.

- Research and pilot projects.

  WPacFIN funds and staff supported a successful pilot shallow-water bottomfish research project in Guam early this fiscal year and has been providing support for a larger follow-up project which should get underway in late June 1998. This project is in direct response to recommendations of the Bottomfish Plan Team for virgin stock and SPR research on the emperorfish complex. A similar project is being supported in the CNMI. Additionally, the WPacFIN Program Manager has met with out-island agency scientists, manager, and data collecting staff to discuss alternatives for establishing specific research projects and monitoring programs to begin filling new data and information requirements created by the SEA (e.g., bycatch, charter boat, and recreational fishery statistics).

Plans–Much work needs to be done over the next several years to upgrade the island agencies and the central WPacFIN office to the level required to meet local and federal fishery management needs. The data and information requirements of the Magnuson-Stevens and Sustainable Fisheries Acts are quite substantial and meeting these will require sizable financial and personnel investments in central WPacFIN and island agencies. The increased level of funding that has come through the PacFIN budgeting process is critical to the success of central WPacFIN and the island agencies in implementing improvements to the data systems. However, even at these increased levels, sufficient funds are not available to meet all of the needs. In particular, additional funds are

needed to expand Hawaii's data programs to include routine monitoring of the charter boat and recreational fisheries sectors. Fully implementing a Dealer Reporting System in Hawaii will also require additional support which is currently not identified.

Information Required by SFA

Sustainable Fisheries Act

Background–The Magnuson-Stevens Act, also called the Sustainable Fisheries Act (SFA) requires that all fishery management plans FMPs contain new definitions and provisions (below). Thereby, the nation is attempting to improve resource stewardship by mandating consideration of a broad spectrum of biological, ecological, and social impacts of fisheries. Most of the research conducted by four of the five Investigations at the Honolulu Laboratory (Fishery Management and Performance, Stock Assessment, Fish Biology and Ecology, Ecosystems and Environment) is directly applicable to the SFA provisions. Specifically, this research supports the WPRFMC FMPs for pelagics, bottomfish and seamount groundfish, crustaceans, and precious corals fisheries. The most salient SFA provisions (including those covered in other sections of the program review) address:

- **Bycatch**: Fish which are harvested in a fishery, but which are not sold or kept for personal use; includes economic discards and regulatory discards.

- **Recreational, charter, and commercial fishing:** Charter fishing is fishing from a vessel carrying a passenger for hire. Commercial fishing is fishing in which the fish harvested, either whole or in part, are intended to enter commerce. Recreational fishing is fishing for sport or pleasure.

- **Fishing communities:** These are communities which are dependent on or are substantially engaged in the harvest or processing of fishery resources to meet social and economic needs.

- **Essential fish habitat (EFH):** Those waters and substrates within the EEZ necessary to fish for spawning, breeding, feeding or growth to maturity. "Necessary" means required to support a sustainable fishery. By law, when such habitat occurs outside the EEZ, it is not EFH, rather it is defined as important habitat (IH).

- **Optimum Yield (OY):** With respect to the yield from a fishery, OY is the amount of fish which (a) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; (b) is prescribed as such on the basis of the maximum sustainable yield (MSY) from the fishery, as reduced by any relevant economic, social, or ecological factor; and (c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing MSY in such fishery.

- **Overfishing and overfished:** Overfishing is a rate or level of fishing mortality that jeopardies the capacity of a fishery to produce MSY on a continuing basis.

Significance–The goal of the SFA is to improve fishery management. However, the lack of science or logic in some parts of the SFA is worrisome. For example, no provisions were made regarding rebuilding plans for fisheries where domestic managers control only an insignificant fraction of fishing mortality (highly migratory fisheries dominated by foreign fishing). With the best of intentions, Congress appears in some cases to have mandated outdated or dysfunctional approaches to fishery management (e.g. prescribing MSY as a precautionary limit rather than a precautionary target, giving EFH political boundaries). Unfortunately, important advances in fishery science, such as the discovery of long-term environmental effects on yields, the value of adaptive management, the impossibility of using MSY as a precautionary limit in developing fisheries for under-exploited species, and the value of spawning potential ratio (SPR) thresholds as precautionary limits) are ignored by the legislature. Issues to consider include how to improve future lawmaking and how to minimize wasteful research efforts toward dysfunctional approaches.

Approach–Honolulu Laboratory scientists chair three of the WPRFMC FMP teams and are party to efforts to achieve compliance with the SFA. As team members they provide information derived from longstanding research programs at the Laboratory and also conduct special analyses. For example, bycatch descriptions have been provided from results of lobster and bottomfish research cruises (Fig. 1) and from the longline observer program. Work on fisheries sectors (charter, commercial, recreational) is largely a fishery monitoring task which will require additional efforts (e.g., recreational surveys). WPRFMC has indicated that all the island communities within its jurisdiction constitute fishery communities, and it is not clear what (if any) additional information may be required on that. Published research papers have provided information for describing EFH. Some additional funding has been acquired from NMFS Southwest Region specifically for EFH research on pelagic species. Various geographic information system (GIS) initiatives both at the Laboratory, the Region, and the WPRFMC are also helping to provide EFH information. In relation to habitat effects on stocks and overfishing, advection-diffusion models of larval transport based on Topex satellite altimetry have been used to investigate potential interconnection or isolation of existing bottomfish management regions. Estimates of SPR which correspond to MSY for Hawaiian bottomfish, were also provided from computer simulation models of age-structured populations used to mimic the exploitation dynamics of the stocks. Similar modeling efforts have been conducted for the NWHI lobster fishery as a whole and for individual fishing grounds within that fishery.

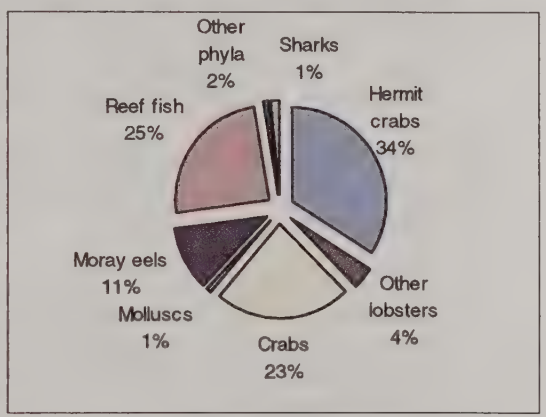


Figure 1: Composition of catches of non-target species in trap hauls in the NWHI (percent of total number) (Source: NMFS research cruises)

Results–Bycatch data provided by NMFS research cruises have provided descriptive information regarding bycatch which has been useful to the WPRFMC in making its initial amendments to the FMPs. Although existing reporting procedures in each fishery do provide a format for bycatch reports, bottomfish, lobster, and pelagic troll, and pelagic handline fishermen rarely report much bycatch. Longline fishermen do a fairly good job of reporting commercial discards, but discards of unmarketable species are not well reported, except by fishery observers (Fig. 2). Thus provisions to reduce bycatch will require additional monitoring efforts.

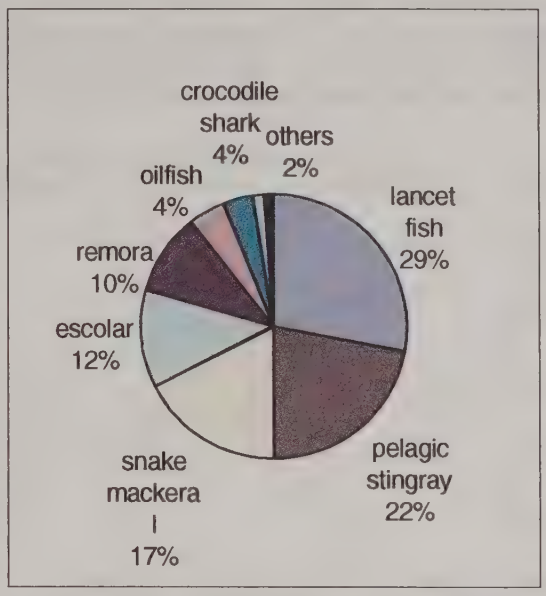


Figure 2. Percent composition of fish species that may be discarded by the Hawaii longline fishery based on NMFS observer data, 1994-97 (Source: NMFS Honolulu Laboratory).

Definition of lobster EFH was assisted by research cruises documenting the pre-exploration abundance of lobsters (Fig. 3) as a function of summit depth of banks in the NWHI (Parrish and Polovina, 1994, Bull. Mar. Sci. 54:151-163). This work also demonstrated that an intermediate level of topographic relief (5-30 cm) characterized the most productive banks.

The WPRFMC's GIS efforts on EFH have focused on mapping of fisheries statistics (Fig. 4) as a proxy for more meaningful definitions. Researchers at the Laboratory periodically review these efforts but focus on a more scientific approach to understanding the fish habitat.

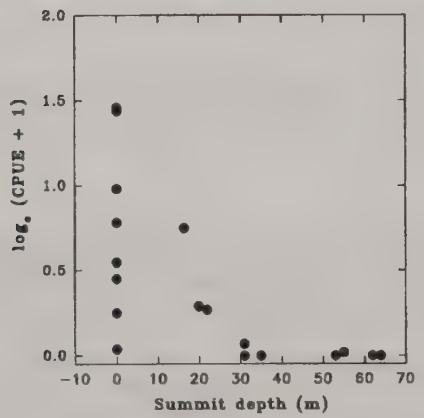


Figure 3. NWHI Lobster CPUE as a function of summit height (from Parrish and Polovina, 1994)

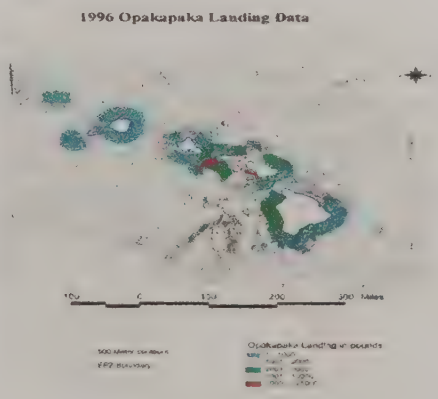


Figure 4. Opakapaka catch.

For example, The Ecosystems and Environment Investigation has defined bottomfish habitat in terms of bathymetry between 30 and 200 fathoms (Fig. 5). Funding for EFH provided by the SWR is being used to investigate the importance of frontal dynamics in the subtropical convergence zone as a foraging habitat for broadbill swordfish (see section on fisheries oceanography) and to document the depth, temperature, and forage preferences of the pelagic management unit species. Also underway is a collaborative effort with an NSF-funded project to model the relationships among exploited species and the food web to show how competition for forage habitat together with

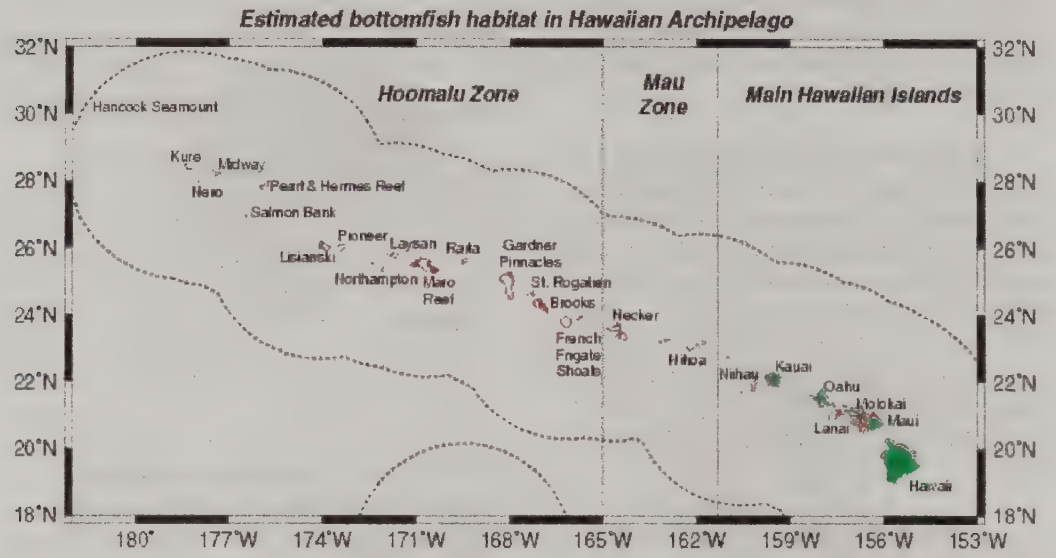


Figure 8. Bottomfish habitat range defined as 30-200 fathoms based on Smith and Sandwell altimetry-derived bathymetry at 2 minute resolution

multispecies exploitation affects fishery production.

Modeling efforts to use the work the HL has accomplished with SPRs to define MSY levels for bottomfish (Table 1) and lobster (Figure 6) are completed and will be updated on a regular basis as part of the FMP process.

Table 1. Bottomfish MSY calculations. The estimated level of fishing effort (E_{msy}) and fishing mortality (F_{msy}) for exploitation at MSY are given for the pooled bottomfish stocks treated as one management complex.

Zone	MSY (lbs)	E_{msy} (days)	F_{msy}
MHI	516,000	1,176	0.32
Mau	131,000	357	0.35
Hoomalu	445,000	664	0.35

The biggest problems with SEA are the provisions for overfishing of pelagic management unit species (also called "highly migratory species"). Precautionary limits must be specified for each species based on MSY and rebuilding plans must be established for any species which is overfished. However, for the majority of these species stock assessments are very outdated or nonexistent. The NMFS cannot conduct stock assessments on these species without international cooperation and exchange of data, an ongoing process yet to reach fruition in the Pacific, where the problem is rendered difficult by the presence of three international organizations competing for the same management role. Unless an international organization adopts a rebuilding plan for an overfished stock, it could not be effective, since only a small fraction of the fishing mortality on most stocks is derived from fisheries under WPRFMC jurisdiction.

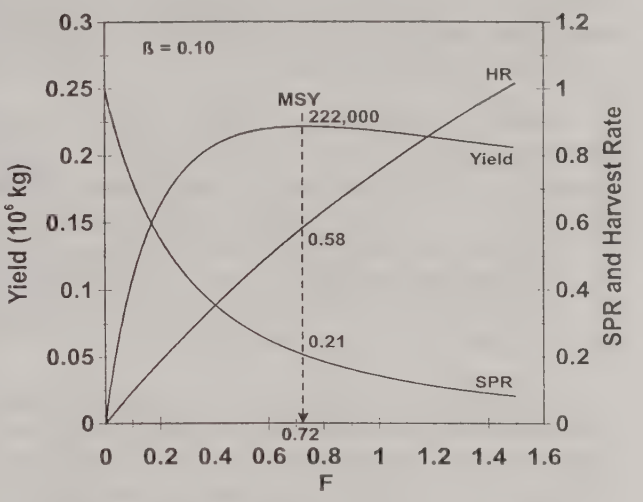


Figure 6. Modeled yield, SPR, and harvest rate (HR), as a function of fishing mortality (F) for the NWHI lobster fishery. Dashed line indicates biological and fishery statistics at MSY.

Plans–The longstanding goals and research activities of the fisheries-related research investigations at the Honolulu Laboratory are properly oriented to address the information needs of the SFA, and such work will continue. Fishery monitoring programs will also need to be greatly expanded, probably to include additional observer programs, if bycatch reduction is to be monitored in all fisheries. We also anticipate need for additional funds for pelagic stock assessment and EFH research. In particular, swordfish and bigeye tuna stock assessment work will require continued funding for conventional and archival tagging research needed to define stock structure and estimate mortality rates.

Resources--The comprehensive nature of SFA means that a major fraction of the Honolulu Laboratory's budget and staff supports research that directly addresses SFA provisions. About half the staff and budget of the Laboratory are directly involved, and when overhead and support staff are included. the total would be more like 70% (about 80 NMFS and JIMAR staff and about $5.0 million). About 8 of the 12 research cruises conducted annually also support SFA provisions. However, the only funding specifically awarded for SFA research was a $140K grant for pelagic EFH work provided by the SWR. This level of funding, staffing, and research cruises must be considered a minimum for the future. In particular, funding for stock assessment, tagging, and EFH researchers who are on temporary JIMAR funds must be continued (ca. $500K needed next year). In addition,

research laboratory space is a key ingredient in the NOAA Honolulu Laboratory renewal project.

Economic Analysis

Honolulu Laboratory economic analysis focuses on supporting WPRFMC fishery management plans (FMPs). Research includes both applied economic analysis and collection of relevant data in relationship to these fisheries, protected species interactions, and seafood markets, as well as broader theoretical research on fisheries management.

With the demise of the SWR/SWFSC socioeconomic research fund in the early 1990s, all quantitative economic research at the Honolulu Laboratory has been funded through the UH/JIMAR focusing on the longline, small boat, and charter boat pelagic fishing fleets. This work has progressed well. However, economic analysis concerning the bottomfish and lobster fisheries has relied on previously collected information (from the early 1990s for the bottomfish fishery and the mid-1980s for the lobster fishery). Updating the longline cost-earnings data base would be an important next step in the JIMAR economic research.

An important new piece of legislation is the Regulatory Flexibility Act (amended in 1996) that allows judicial review of agency assessments concerning the economic impact of regulations on small entities, including small businesses. NMFS is holding a national workshop this fall to discuss methods for meeting the RFA requirements. In the meantime, Ray Clarke of the PIAO has played an increasing role in conducting these applied analyses in collaboration with the Honolulu Laboratory's economist, Sam Pooley. A number of new applied analysis tools should be investigated for these responsibilities.

Resources--Present staff and contractual resources are inadequate to meet the economic data collection requirements of the Magnuson-Stevens Act and the Regulatory Flexibility Act. The addition of one GS 11/12 economist, with adequate travel and contractual support, would go a long way in meeting these needs for the commercial sector of the Hawaii fishery. Access to NMFS Marine Recreational Fishing Statistical Survey funds for estimating the size of the recreational fishery in Hawaii would be a major addition to our capabilities. Economic research needs in the other areas probably need to be addressed through the PACFIN add-on process for WPacFIN.

Hawaiian Monk Seal Issues

Catastrophic Decline in Pup Survival at French Frigate Shoals

Background–Approximately 200 Hawaiian monk seals are born each year, about half at French Frigate Shoals (FFS). Although survival from birth to age-1 has been poor at FFS (Fig. 1), until recently most pups survived through the nursing and early post-weaning period. However, during the past 3 years survival of pups in these early life periods dropped dramatically at FFS. Twenty-seven and forty-six unweaned or newly weaned pups died or disappeared in 1996 and 1997, respectively. Over 60% of the pups born at FFS in 1997 died or disappeared before or within a few months of weaning,

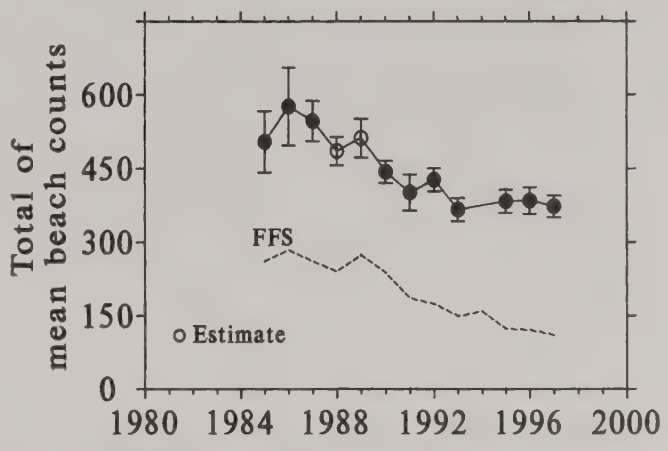


Figure 1. Hawaiian monk seal beach counts over time. Mean beach counts at French Frigate Shoals are compared to the total of the means at all breeding locations.

A shift in pupping locations within FFS has probably impacted pup survival. In the 1980s, East Island was the primary pupping site, but Whaleskate Island become the primary site as the proportion of females at East Island gradually decreased over the last 15 years. Recently, winter storms reduced pupping habitat at Whaleskate, forcing many parturient females from Whaleskate Island to nearby Trig Island, where early-life pup mortality has been high. Two factors have contributed to increased mortality at Trig Island: high levels of aggressive adult male monk seal activity and shark predation. During the 1997 field season researchers confirmed the identity of two adult male monk seals, and possibly two others, that were directly responsible for the deaths of several pups. These males were observed aggressively attempting to restrain or mount 11 pups, 4 of which were injured and 7 of which were killed at about the time they were weaned.. In addition, during this period of high pup mortality, several individually identifiable Galapagos sharks (*Carcharhinus galapagensis*) were observed pursuing live pups of all ages, and the incidence of pup injury and death increased.

The recent sharp increase in mortality of nursing and newly weaned pups, which is in addition to already poor survival from birth to age one at FFS, can have significant negative impact of the overall Hawaiian monk seal population since almost half of the entire seal population occurs at FFS (Fig. 2).

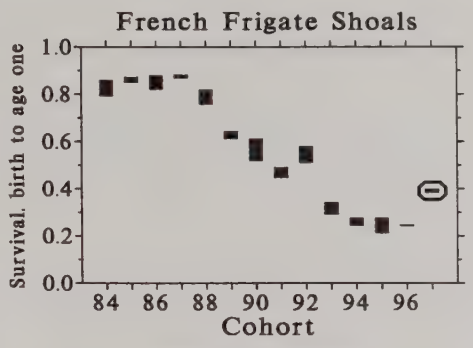


Figure 2. Proportion of Hawaiian monk seal pups born at French Frigate Shoals that survive to age one, relative to year of birth.

Honolulu Laboratory Hawaiian Monk Seal Program (HMSP) staff proposed to mitigate the high early-life pup mortality at FFS during the 1998 field season by relocating male seals identified as being responsible for killing pups and by lethally removing specific sharks identified as being responsible for killing pups. The Hawaiian monk seal Recovery Team (HMSRT) concurred with these recommendation and applications for appropriate permits to take these actions have been submitted.

Approach

- Conduct extensive daily observations of pups at Trig Island to assess incidence of adult male seal attacks and shark predation on pups.
- If they return, remove adult males that killed pups in 1997 and endanger or kill pups in 1998. Identify other aggressive adult males.
- Conduct a study of the interaction between sharks and monk seal pups to understand and mitigate the role of sharks in pup mortality at Trig Island. Use spaghetti tags or natural marks to identify sharks observed patrolling waters adjacent to pupping beaches. Lethally remove up to five individually identified sharks responsible for predation on monk seal pups.

Results

- Both males responsible for killing pups in 1997 returned in 1998. One male was collected, and held in a temporary holding pen on Tern Island after drowning a pup (Fig. 3). Researchers intervened and collected the other male when seen aggressively mounting a pup. These males were translocated to Johnston Atoll via the Coast Guard cutter *Kiska*, and released into the lagoon near Sand Island at Johnston Atoll on June 8, 1998. The locations of these two seals are

Figure 3. An adult male Hawaiian monk seal immediately after drowning a pup.

being monitored by satellite technology.

- Shark activity remains high at Trig Island in 1998, with identifiable sharks pursuing pups in nearshore waters. One pup was found dead with an amputated hindflipper and hip, and two neonatal pups disappeared. Two live pups sustained major shark injuries; one lost both hindflippers and a portion of its lower body (Fig. 4) , and the second pup sustained a large gaping wound on its side. In addition, two pups have been killed and eaten during observed attacks. Identifying marks were recorded for both sharks involved in one of these attacks. A permit to lethally remove up to five sharks responsible for killing seal pups was received from the FWS in early June. This action will be undertaken as the specific sharks are encountered.

Figure 4. A Hawaiian monk seal pup that survived a shark attack. This pup lost both hind flippers and a portion of its lower body.

Plans

- Continue monitoring adult male and shark interactions with pups at FFS.
- Remove additional adult male seal or sharks to mitigate high pup mortality rates as necessary.
- Expand studies if pup mortality remains high or increases.

Resources

- FY 1998

  Monitor adult male/shark interactions with pups, 1.0 JIMAR staff year.

- FY 1999

  Monitor adult male-shark interactions with pups, 1.0 JIMAR staff year.

  Expand studies to assess pup mortality rates (pending results of 1998 field season), 2.0 JIMAR staff years.

Submerged Derelict Fishing Netting Serious Hazards to Seals

Background Information–Based on studies by the Honolulu Laboratory, derelict fishing nets and other marine debris fouled on submerged nearshore reefs and within the lagoons of the atolls is probably causing a large number of deaths of Hawaiian monk seals. Figure 1 shows a dead seal that was encountered by Laboratory scientists while surveying submerged marine debris at Pearl and Hermes Reef in the NWHI. The seal apparently drowned after becoming ensnared in large clump of derelict netting snarled on a coral head. The seal shown in Figure 2 was also snared in the same clump of netting, but was lucky enough to be freed by NOAA divers before it drowned. There is increasing evidence that removal of submerged marine debris from the habitats of the Hawaiian monk seal may be a major mitigation action that will be required to recover this highly endangered species. In addition, to killing monk seals, the submerged derelict netting and other marine debris destroy areas of coral reef, which is important habitat for fish and other reef ecosystem life. This results as masses of marine debris material accumulate, break away, and are rolled or moved over reef areas by the ocean swell and other water movements..

Figure 1. Juvenile Hawaiian monk seal drowned in submerged derelict net, French Frigate Shoals.

Figure 2. NOAA diver frees Hawaiian monk seal from derelict net, French Frigate Shoals.

The impacts of marine debris on wildlife are well documented, with a recent estimate that 267 marine species have ingested or become entangled in marine debris. Pinnipeds may be particularly susceptible to entanglement, with 19 of the 33 extant species of pinnipeds documented as having become entangled. General concern over the impact of marine debris resulted in the ratification in 1988 of Annex V of the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL). Annex V was intended to reduce the risks to wildlife from marine debris by prohibiting ocean dumping of plastics. Nonetheless, the amount of entangling debris washing ashore in the Northwest Hawaiian Islands has shown no sign of diminishing (Fig. 3), despite the implementation of MARPOL Annex V. Most of the debris documented; i.e., nets and lines, were clearly from the fishing or other maritime industries. Vessels may be continuing to dump debris despite regulations, or may be losing gear during normal operations.

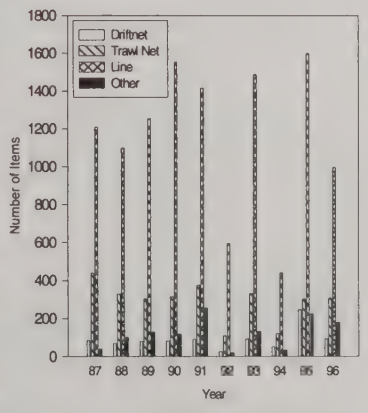


Figure 3. Number of potentially entangling debris items recovered from NWHI beaches, 1987-96.

During breeding seasons of the Hawaiian monk seal, Protected Species Investigation (PSI) biologists regularly monitor the beaches on which seals haul out, removing any debris which could entangle the animals. Biologists also, whenever possible, release any seals which have become entangled in debris. In the 16-year period from, 1982-97, 155 entanglements of seals have been observed, representing approximately 0.63% of the population annually (Fig. 4). This is the highest rate observed for any pinniped species, significantly higher than the 0.4% for the Northern fur seal, a species for which the threat of entanglement has been well publicized. Although few (five) Hawaiian monk seal deaths have been observed from entanglement on beaches, most of the 155 incidents resulted in the animal being rescued/released by on-site biologists--lacking human presence, more mortalities would have resulted.

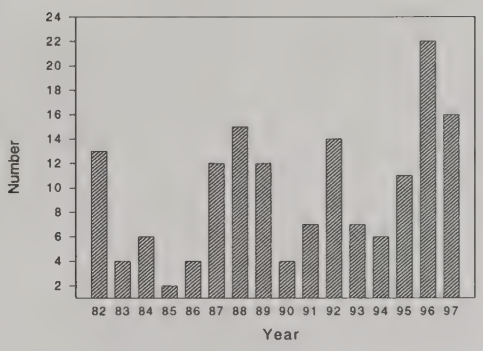


Figure 4. Number of Hawaiian monk seal entanglements observed, 1982-97.

Laboratory Actions in Response to the Issue–In late 1996, the Laboratory initiated a feasibility study to assess the amount of debris present on nearshore reefs at Pearl and Hermes Reef and French Frigate Shoals. in the Northwestern Hawaiian Islands. Through February, 1998, four cruises of the NOAA ship *Townsend Cromwell*, from which teams of divers worked, have surveyed and removed large amounts of debris.

Approach

- Survey reef areas using divers on tow boards to estimate density of nets.
- Remove the largest nets or those considered to present the greatest entanglement threat to Hawaiian monk seals.
- Document the percent, by weight of coral rubble within the net fragments retrieved.
- Establish a cleaned study site for future monitoring to establish an estimate of accumulation rate.

Results

- Based upon observed densities, approximately 38,000 nets are present at Pearl and Hermes Reef and at French Frigate Shoals.
- Densities of net fragments within the lagoons are estimated to be 94/km^2 at French Frigate Shoals, and 64/km^2 at Pearl and Hermes Reef.
- Densities vary within locations at each site.
- Approximately 4,400 kg of nets were removed.

- The masses of derelict netting and other marine debris in some cases destroy large areas of coral reef habitat. Coral rubble comprised approximately 20% of the retrieved nets by weight.

- Based upon present limited resources, it is estimated that removal of all debris would take over 10 years each at French Frigate Shoals and Pearl and Hermes Reef. Removal of debris in areas more critical to seal survival (e.g., reefs in the vicinity of seal pupping areas at those two locations) could be accomplished sooner.

Plans--The Honolulu Laboratory recognizes that entanglement in marine debris may be a major factor inhibiting recovery of the Hawaiian monk seal. It is apparent that a large-scale effort to remove debris from the seals' aquatic habitat will require significantly greater effort than is currently available. The following efforts will be undertaken in FY 1999.

Coordinate a multi-agency cooperative effort among military, civilian government, and private agencies to clean certain reefs within the NWHI.

- Encourage NGO involvement to assist in clean-up of submerged marine debris.

- Conduct one cruise on the *Townsend Cromwell* during which submerged debris will surveyed and be removed from reefs in the NWHI.

- Provide technical expertise to other organizations on methods of reef cleanup and provide training to personnel when necessary.

- Collect data on size and general type of debris,

- Retain selected samples in an effort to identify the debris and its sources.

Resources

- FY 1998

  Approximately 0.50 staff year labor funded by JIMAR funding; approximately 0.25 staff-year NMFS labor

- FY 1999

  Approximately 0.50 staff year labor funded by JIMAR funding; approximately 0.25 staff-year NMFS labor. Proposals have been submitted to increase the number of staff years required to expand this project.

Assessing Potential Hawaiian Monk Seal/Fishery Interactions

Background Information--Efforts to enhance the recovery of Hawaiian monk seals require an understanding of the natural and anthropogenic factors influencing their foraging success. Recent studies have indicated that variation in the oceanic environment and marine productivity around the Northwestern Hawaiian Islands (NWHI) has likely reduced the availability of monk seal prey species. However, the level of interaction between monk seals and commercial fisheries remains poorly understood. Concern over the potential for fishery interactions helped to promote designation of "critical habitat" for the monk seal in 1986. Subsequently, management actions were initiated that prohibited lobster fishing in waters less than 10 fm around all NWHI. In 1988, the critical habitat was expanded to include Maro Reef and waters around existing major haulout sites out to 20 fm. After indications of direct fishery interactions, additional protection of monk seal habitat was provided by the establishment of a Protected Species Zone (1991) which prohibited longline fishing within 50 nmi around the NWHI and corridors between islands (Fig.1).

Potential direct or indirect interactions between monk seals and the lobster fishery in the NWHI have been an issue of concern. The Marine Mammal Commission (MMC) has suggested that the take of lobster and the associated bycatch (e.g., octopus) has reduced the availability of monk seal prey resources, especially for juvenile seals at French Frigate Shoals (FFS). A lack of lobster fishing at FFS over the last 8 years does not support this speculation. Nonetheless, more work is required to address this potential interaction by determining the importance of lobster in the diet of the monk seal and by evaluating the impact of this fishery on the benthic coral reef ecosystem.

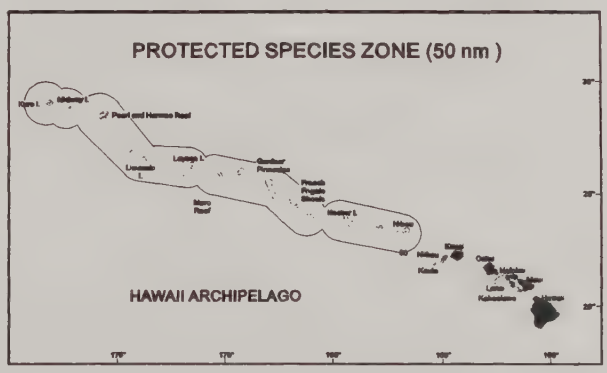


Figure 1. Northwestern Hawaiian Islands, showing 50 nmi Protected Species Zone in which longline fishing is prohibited.

Recent studies also indicate that there is a potential for interactions between monk seals and commercial bottomfish fisheries. Pilot studies have shown that monk seals commonly dive to depths ranging from 10-200 meters and forage on commercially valuable fish. It is possible that bottomfish are a more important component of the monk seal diet than originally thought, and additional information is needed to assess potential interactions with this fishery.

More information is also needed to validate the current 50 nmi exclusion of longline fishing in the Protected Species Zone around monk seal reproductive sites in the NWHI. Maintenance of the existing boundaries in the future will require the ability to define pelagic habitat use by monk

seals. Definition of foraging habitat will also be critical for Section 7 consultations concerning recent attempts to initiate a precious coral fishery in the NWHI.

Laboratory Actions in Response to the Issues–Understanding the foraging ecology of the monk seal is essential for identification and mitigation of potential fishery interactions and is consistent with the strategic goal of enhancing the population growth of the endangered Hawaiian monk seal. Three primary research categories require investigation to address concerns associated with possible conflicts between commercial fisheries and monk seals.

- Characterize monk seal foraging habitat.
- Monitor prey selection and identify important species.
- Monitor prey availability and abundance.

Approach

Habitat

- Identify foraging habitat through the deployment of satellite linked time/depth recorders on adult males, adult females, juveniles, and weaned pups.
- Characterize foraging habitat by deploying video cameras "crittercams" on adult males (reduction in instrument size is required for use on juveniles).
- Use remote video drops to define the area of foraging habitat of monk seals.

Prey Selection

- Analyze scats/spews to monitor prey consumption and to provide an indirect index of prey availability/abundance.
- Validate the presence/absence of selected prey (e.g., lobster) in the diet of monk seals through the use of fatty acid analysis.

Prey availability/abundance.

- Conduct trend-site assessments of prey availability/abundance through reef fish surveys and modify techniques to more accurately monitor monk seal prey resources.

Results--Preliminary analyses from pilot studies at FFS and Pearl and Hermes Reef (P&H) indicate that adult monk seal diving occurs in three depth categories: 10-60 m, 100-200 m, and 250-550m. Variation in diving behavior and distances traveled from the haulout sites seems to be influenced by breeding site, sex, and age. The distances traveled (Fig. 2) and dive depths of seals from FFS were typically greater than those of seals from P&H. (NMFS, University of Minnesota and Hubbs Sea World Research Institute).

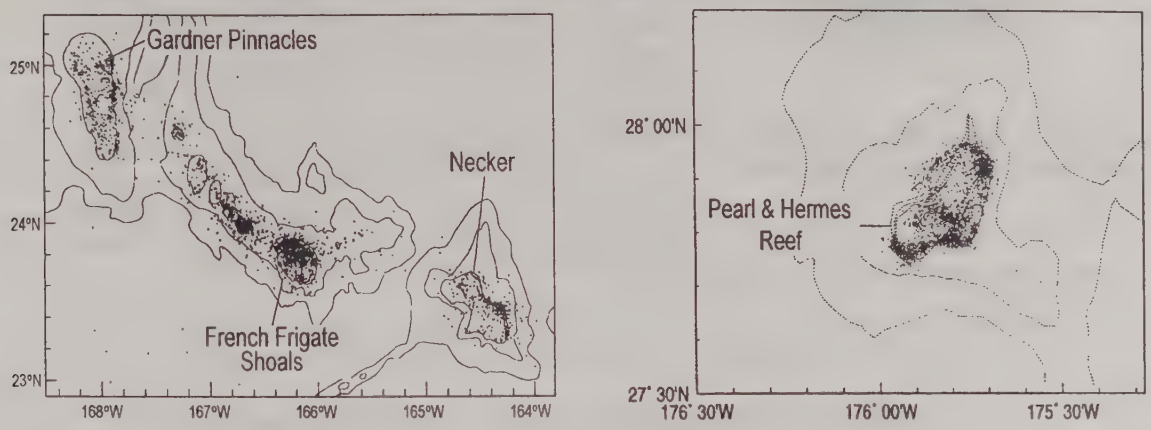


Figure 2. Satellite-linked locations of Hawaiian monk seals instrumented at French Frigate Shoals (left) and Pearl and Hermes Reef (right).

The deployment of crittercams on male monk seals at FFS has indicated that foraging occurs primarily in benthic/demersal habitat at approximately 60 m (Fig. 3). Seals ignored fish communities in the water column associated with coral reefs and focused on cryptic fauna in the transition zones where consolidated substrate, rubble, and debris border areas of sand. Independent video assessments of FFS indicate that this type of habitat represents a small percentage of the overall demersal habitat. [NMFS and National Geographic Society]

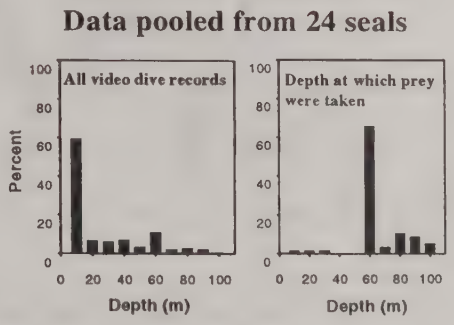


Figure 3. Percent of dives of 24 adult male Hawaiian monk seals at French Frigate Shoals, showing all dives (left) and dives on which prey were taken (right).

From 1991 to1994, scat and spew samples from five main breeding locations have provided valuable insight to the relative importance of various prey species in the diet of the monk seal (Fig. 4). Prey types identified were comprised of approximately 79% teleosts, 16% cephalopods, and 5% crustaceans. Monk seals appear to be generalist

feeders that forage on a wide variety of prey (30 families of fish, 21 species of cephalopods, and several unidentified crustaceans). However, the analysis of scats and spews probably does not reflect the importance of some prey (e.g., lobster) due to differential retention of hard parts in the gut. [NMFS, University of Hawaii (G. Lowe)]

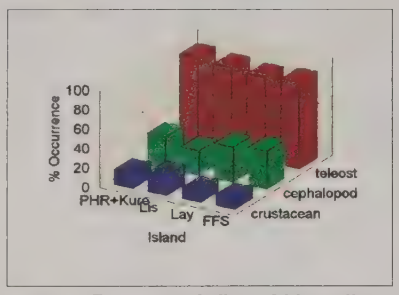


Figure 4. Percent of diet of Hawaiian monk seals, according to representation in scats.

Ongoing assessments of reef fish populations at French Frigate Shoals and Midway Atoll have been used to monitor ecosystem changes which have been correlated to variation in oceanic currents and productivity (Fig. 5). Continuing investigations will attempt to identify links between reef fish assessments and prey assemblages found in benthic/demersal monk seal foraging habitat. Such results will be used to evaluate trends in the productivity of the NWHI ecosystem and associated changes in the availability/abundance of monk seal prey.

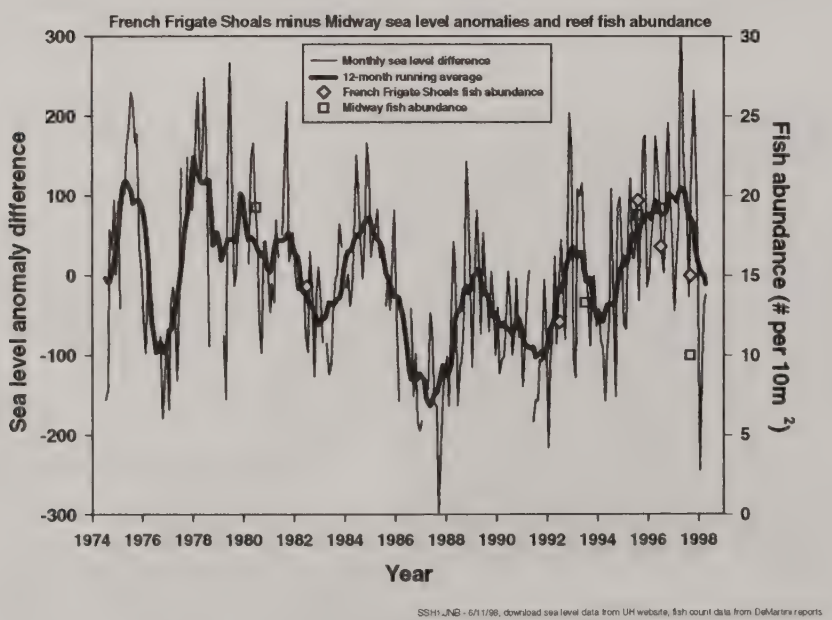


Figure 5. Sea level anomalies (French Frigate Shoals minus Midway) and reef fish abundance, 1974-1998.

Plans

- Complete pilot studies using satellite-linked time depth recorders to characterize monk seal foraging habitat, publish results and expand studies to include the evaluation of juvenile monk seal foraging habitat.

- Refine crittercam studies to include night and deep water foraging through the use of low power light sources.

- Continue remote video drops to map monk seal foraging habitat.

- Continue analysis of scats and spews.

- Complete preliminary evaluation of fatty acid technique for assessing prey species of monk seals.

- Expand ongoing reef fish surveys to include demersal/benthic assessment of monk seal prey assemblages at 60 meters.

  Assess monk seal habitat as it relates to proposed precious coral fisheries and Section 7 consultations using UH/HURL submersible and ROV.

Resources

- FY 1998

  Satellite telemetry studies: 0.10 NMFS staff year; 0.25 contract.

  Ctittercam studies: 0.25 NMFS staff years; 0.5 JIMAR; 0.5 National Georgraphic Society.

  Scat/spew analysis, assessment field staff (collect/process only).

  Fatty-acid prey identification: 0.10 JIMAR staff year; 0.10 contract.

  Reef fish/demersal/benthic prey : 0.25 NMFS staff year; 0.25 JIMAR; dedicated 30-day cruise.

  Coral fishery interaction: Dedicated HURL cruise.

- FY1999

  Satellite telemetry studies: 0.10 NMFS staff year
  Additional requirements: 2.0 staff years (submit proposal); two 30-day dedicated cruises proposed.

Ctittercam studies: 0.25 NMFS starr year, 0.5 JIMAR, 0.5 National Geographic Society.

Additional requirements: 1.0 staff year (submit proposal to expand studies).

Scat/spew analysis: Assessment field staff (collect/process only)

Additional requirements: 2.0 staff years (submit proposal).

Fatty-acid prey identification: 0.50 staff year (contract pending results of pilot study).

Reef fish/demersal/benthic prey: 0.25 NMFS staff year, 0.25 JIMAR; dedicated 30-day cruise.

Addtional requirements: HURL proposal.

Care of Captive Hawaiian Monk Seals With Eye Ailment

Background Information–The burdens of housing and care required for maintaining 10 female Hawaiian monk seals at the Honolulu Laboratory Kewalo Research Facility have seriously hindered efforts to enhance the recovery of the endangered species. These seals were collected in 1995 as undersized, newly weaned pups from French Frigate Shoals and brought to Oahu for rehabilitation (Fig. 1). It was planned that after successful rehabilitation, which usually takes about 6 to 8 months, they would be released at Midway Island. However, most of the pups developed an eye condition which prevents their release into the wild. The annual costs for their care and husbandry have ranged from approximately $273K to $552K, depending on costs associated with diagnostic testing and facility maintenance and improvements (Table 1). In FY1998, only $170K was received from the NMFS Office of Protected Resources (F/PR) for maintaining the seals. and it was necessary to make up a funding shortfall by re-directing funds from high priority monk seal recovery projects.

Figure 1. Two young female seals at NMFS Kewalo Research Facility.

Hawaiian Monk Seal Captive Care Budget (1,000s)

	1998	1999 (est.)
Captive care		
Labor	$137	$131
Non-Labor	75	94
Eye disease	25	0
Facility improvements	10	0
Overhead	26	25
	$273	$250

Table 1. Hawaiian monk seal captive care budget, 1997-98.

During the seals' time in captivity, numerous investigations have been conducted to elucidate the etiology of the eye condition. Although the cause of the condition has not been determined, much has been learned about health evaluation and diagnostic testing. Growth patterns of the pup and juvenile stages of monk seals including seasonal differences and molt patterns have been monitored. Drug immobilization studies will also be conducted to improve safety when handling monk seals during future research projects.

Extensive efforts have been expended to place the seals in research or display facilities. The Marine Mammal Commission and F/PR have stated that foreign placement of the seals would not be considered until an exhaustive search for domestic facilities to take the seals has been completed. While several domestic marine aquarium facilities have expressed initial interest in obtaining these monk seals, none have committed to taking them. Placement efforts have been initiated to investigate the possibility of transferring the seals to foreign facilities. At this point, two marine aquaria in Japan and one in Portugal have expressed serious interests in obtaining these seals.

Laboratory Actions in Response to the Issue–Protected Species Investigations, in cooperation with SWFSC and the SWR, has developed an action plan to canvass the international marine mammal community to find an appropriate permanent home for these animals.

Approach

- Provide excellent care and husbandry.
- Conduct health assessment and research.
- Identify characteristics of appropriate alternative facilities, which include:

  Limited exposure to wild and captive pinnipeds.

  Quality air and water environment that meet APHIS/AWR specifications.

  Stable and sufficient financial resources for continued maintenance and care of the animals.

- Advertise availability of seals.

  Contact marine mammal community leaders.

  Publish information in appropriate newsletters.

  Prepare information packet and video of seals.

  Send information to appropriate facilities.

- Identify pertinent relocation regulations and requirements.

  Define financial responsibility.

  Determine permit requirements.

  Specify criteria for allowable activities (e.g., research).

- Conduct immobilization studies on seals prior to relocation.

Results

- Care and husbandry.

  Document growth patterns of captive seals relative to food ration and identified change in mass related to the molt (Fig. 2).

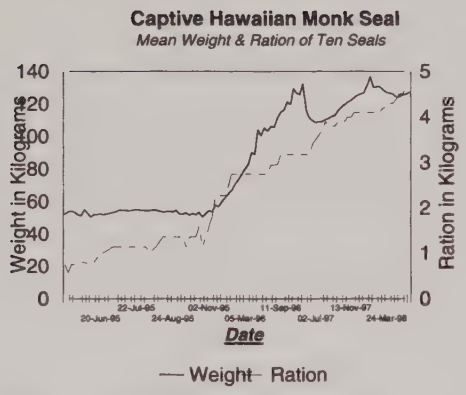


Figure 2. Mean weight (solid line) and ration (dashed line) of 10 captive female Hawaiian monk seals.

Captive Hawaiian Monk Seal
Mean Blood Parameters

BLOOD PARAMETERS	*MEAN*	*STDV*
White Blood Cell Count	7.10	06.29
Red Blood Cell Count	3.02	0.14
Hemoglobin	16.34	0.49
Fibrinogen (Quant.)	281.27	33.92
Glucose	91.47	29.88
SGPT	78.65	27.53
SGOT	120.72	195.59
Blood Urine Nit	18.85	6.50
Creatine	28.23	8.85
GGT	6.28	1.95

Table 2. Mean blood parameters of 10 captive Hawaiian monk seals.

- Health assessment and research.

  Complete extensive health evaluations.

  Obtained normal blood values
  (Table 2)

  Validated serological testing.
  Developed cell lines for disease identification

  Conducted ocular examination and biopsy.

  Investigations of monk seal eye condition.

  Continue monitoring virus titers.

  Use immunohistochemistry for herpesvirus isolation.

  Nutrition probably not related eye condition.

  Attempt to isolate virus using Hawaiian monk seal cell lines.

  Continue hematology and serology testing.

  Evaluation of eye condition.

  Epidemiology consistent with infectious disease.

  Etiology likely viral.

- Complete exhaustive search for domestic facility.

  Conducted intense effort to relocate seals since December 1997.

  Notified more than 30 marine mammal community leaders.

  Sent announcement to membership of American Zoo and Aquarium Association and the Alliance for Marine Mammal Parks and Aquariums.

  Contacted more that 25 appropriate facilities and distribute a processionally produced video.

  Identified one possible domestic facility, but no offers to date.

  Identified three interested foreign facilities (1-Portugal, 2-Japan).

Plans–Investigations of the eye condition will continue and immobilization studies will be conducted to assess the use and safety of alternative drugs to diazepam.

Having concluded an exhaustive search of potential domestic facilities, efforts to place the seals in foreign facilities will be evaluated. Attempts will also continue to promote interest in relocating the seals at domestic facilities.

Resources

- FY 1998 staff years

  Two full-time animal care staff (JIMAR), 0.50 facility manager (NMFS), 0.25 epidemiologist, 0.50 contract veterinarian on contract.

- FY 1999 staff years.

  If seals remain in NMFS care: two animal care staff (JIMAR), 0.50 facility manager, (NMFS), and 0.50 contract veterinarian.

Fibropapilloma Disease of Marine Turtles

Background Information--Fibropapilloma (FP) is a tumor-forming, debilitating and often fatal disease of sea turtles that has rapidly emerged in the past decade as a potentially serious threat to populations worldwide. The disease is manifested by the formation of multiple fibrous masses of tissue 1 mm to 30 cm in diameter, growing from the eyes, flippers, neck, tail, seams of scutes, and in the mouth. The tumors also form in the internal organs. Although most FP tumors are histologically classified as benign (noncancerous), they can significantly disrupt the vital life functions of breathing, feeding, vision, and swimming. In advanced stages of the disease, turtles will often be lethargic, emaciated with soft and sunken plastrons, and prone to stranding ashore. Abnormal serum chemistry and blood cell counts are present. In addition, the pathology of FP is often associated with heavy burdens of internal parasites consisting of spirorchid cardiovascular flukes. FP has been shown to be transmissible in laboratory studies using injected cell-free tumor extracts.

The prevalence of FP is highest in the herbivorous green turtle, *Chelonia mydas*, the species in which the disease was first described in the scientific literature as a rare curiosity from the Florida Keys in the 1930s. In the Hawaiian Islands, the earliest verifiable case of FP dates back to only 1958 when a heavily tumored green turtle was captured (and killed) in Kaneohe Bay, Oahu. At present, green turtles in Hawaii and Florida demonstrate high prevalence of FP, ranging up to 90% at certain coastal foraging areas. Elsewhere in the Pacific, FP in green turtles is currently limited to a few but potentially significant sites in Australia, Indonesia, and the Bonin Islands where moderate prevalence has been reported, but insufficient research has been conducted. Outside of the Hawaiian Islands, sea turtles at other insular sites of Polynesia, Melanesia, and Micronesia are virtually free of the disease.

An issue that must be urgently addressed is the emergence of FP within the past few years at elevated levels in sea turtle species other than the green turtle. Olive ridleys, *Lepidochelys olivacea*, nesting in the eastern Pacific in Oaxaca, Mexico and at Ostional, Costa Rica have shown increased FP prevalence. A similar occurrence has taken place in Australian loggerheads, *Caretta caretta*, foraging at Moreton Bay adjacent to Brisbane in Queensland. It is noteworthy that molecular genetics research by the SWFSC has shown that some pelagic-phase olive ridleys and loggerheads from these populations occur in the North Pacific and are incidentally taken in the Hawaii-based longline fishery. Loggerheads foraging in southern Florida have also shown increased FP prevalence, but to date the severity of the cases has not equaled what has been recorded in green turtles.

In 1990 the Honolulu Laboratory convened the first expert workshop on FP to exchange information, discuss strategies, and formulate a Research Plan to guide studies of the etiology, pathenogenesis, virology and epidemiology of the disease (Balazs and Pooley, 1991 "Research Plan for Marine Turtle Fibropapilloma"). Since that time the Honolulu Laboratory has been the leader within NMFS in FP research through the conduction of epidemiological field studies and collaborative projects created through

research partnerships with a worldwide array of outstanding disease specialists. In December 1997 the second expert FP workshop was convened by the Honolulu Laboratory to examine progress and redefine research priorities in view of advances made in recent years. During the 8 years between the two workshops, the number of journal publications and reports dealing with FP soared from 35 to 173. This reflects the intense interest in and concern for sea turtles afflicted with this enigmatic and scientifically challenging disease.

It is essential that the exact cause(s) of FP be determined along with the mode(s) of transmission in wild populations. Based upon the most recent results, the disease has a complex multi-factorial etiology involving two or more viral agents (herpes virus and retrovirus). However, the involvement of undetermined environmental co-factors, somehow predisposing turtles to FP, appears very likely. The identification of the causative viral agent(s) will permit the development of a diagnostic field test that can facilitate collection of vital management-oriented information (i.e., immunity, exposure, infection and recovery rates). Such data are fundamental to formulating disease containment, control, and possibly even prevention strategies. In addition, the existence of a reliable diagnostic test will allow for an informed response to any outbreaks of FP that may eventually occur at one or more of the currently unafflicted insular Pacific island locations.

The Honolulu Laboratory's role and responsibilities in pursing FP research are based upon several interrelated factors of significance to NMFS, as follows: 1) sea turtles are listed as threatened and endangered species mandated for ESA recovery in partnership with FWS and the impacts of FP to population recovery are unknown; 2) the overall health of coastal marine ecosystems (a NOAA focus) at FP locations is in question; 3) mortalities and morbidities from FP are highly visible to the public, especially Hawaii's burgeoning sea turtle eco-tourism industry, thereby exacerbating pressures on the agency to find solutions; 4) requests are increasing for international assistance and training in conducting research in areas where FP has emerged in other sea turtle species; 5) concern by insular Pacific island nations that emergence of the disease in their area will cause already deleted, but culturally important, local sea turtle populations to become inedible or go extinct; and 6) concern over potential human-health issues of diseased turtles, most recently involving efforts by native Hawaiians and the WPRFMC to seek a limited take of green turtles for consumption.

Laboratory Actions in Response to the Issue–The Honolulu Laboratory's fibropapilloma disease research supports the NOAA Fisheries strategic goal of "recover protected species" as well as top priority actions in the 1998 U.S. Pacific Sea Turtle Recovery Plans. The goal of the research is to better understand the dynamics of FP in relation to healthy and sustainable sea turtle populations, and the vital habitats upon which they depend, in Hawaii and elsewhere in the Pacific region. The research activities include the following:

- Conducting baseline studies of the biology, ecology, and life history of sea turtles.

- Conducting investigations of the etiology, pathology, immunology, and epidemiology of turtles with FP.

- Developing computer models to simulate population impacts of FP relevant to survival, mortality, growth rates, and other key factors.

- Monitoring trends in the number of nesting females as a measure of population status and recovery.

- Assessing the role of potential environmental co-factors such as dinoflagellates on turtle forage as biotoxic tumor promoters.

- Conducting investigations to identify modes of FP transmission between turtles.

- Examining fibropapilloma in other species of Pacific sea turtles.

- Training and exchanging information with other researchers where fibropapilloma has emerged.

Approach

- Capture, health-screen, collect blood and biopsies, record morphometrics, and tag to permanently identify individuals and to quantify turtle aggregations at designated long-term coastal study sites.

- Conduct annual systematic monitoring and tagging to determine number of nesters and their health status at French Frigate Shoals in the Northwestern Hawaiian Islands.

- Quantify and salvage stranded turtles for necropsy to collect epidemiological data and biological samples including bones for skeletochronology.

- Collaborate with other Laboratory scientists to contribute field data and expertise in developing and refining computerized simulation models.

- Establish productive partnerships through collaboration and contracting with an array of highly specialized disease researchers in order to make progress on FP.

- Host researchers from Pacific island and Pacific Rim nations to exchange information and receive training on FP research. Visit projects outside of Hawaii to conduct training and collect samples for cooperative research.

Results

- Epidemiology of FP in the Hawaiian Islands.

  The prevalence of FP in the Hawaiian Islands has remained high in stranded turtles (Fig. 1) and at key long-term in-water study sites of Kaneohe Bay, Oahu and Palaau, Molokai (Fig. 2, 3). In contrast, no cases of FP have as yet been

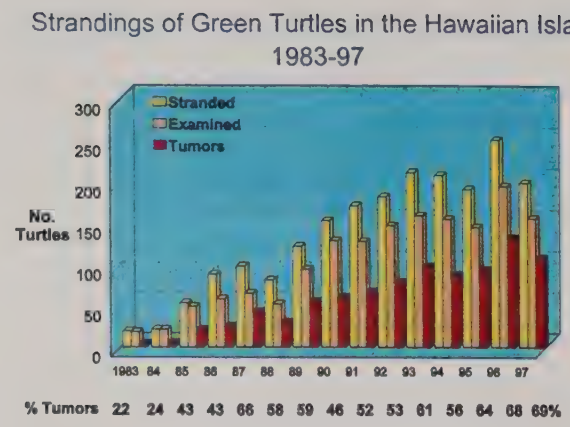


Figure 1

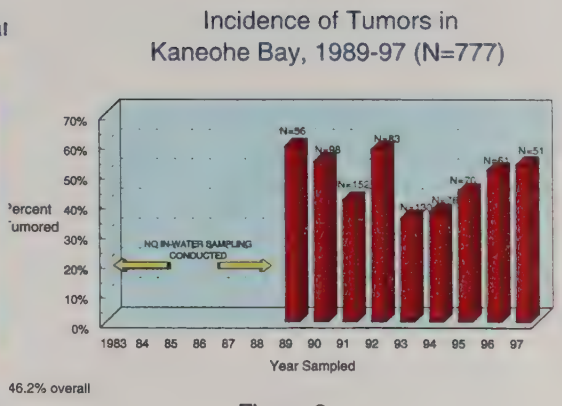


Figure 2

encountered among the 600 turtles tagged and assessed along the 100-km

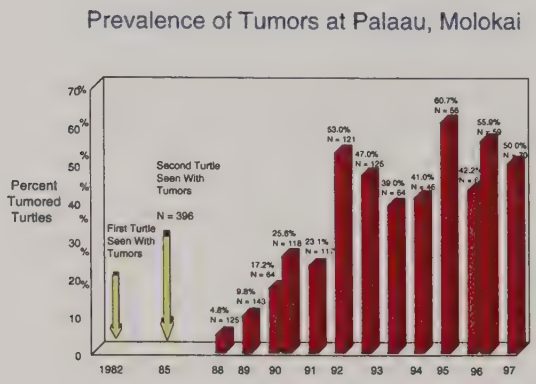


Figure 3

western coastline of the Island of Hawaii. Severe cases of FP, based on a progressive tumor scoring system of 0-3, have declined in Kaneohe Bay from 1989-97, which is probably a reflection of die-offs seen in strandings. Growth rates of turtles with severe FP in Kaneohe Bay are significantly slower than moderately or unafflicted turtles (1.0 vs 2.2 cm/yr in carapace length). Oral tumors are present in 17% of FP cases. Up to 87% of FP turtles that are recaptured show an increase in severity, while very few (4-8%) exhibit regression.

- Role of viruses - etiology, isolation and identification.

  Highly specialized Polymerase Chain Reaction Amplification and other techniques have identified an alphaherpesvirus, a retrovirus, and a

papillomavirus in FP-afflicted tissues as the result of collaborative research with Cornell University, the University of Florida, JIMAR, and the University of Hawaii's Retrovirus Research Laboratory. Virus isolation efforts are in progress as a prerequisite for transmission studies to verify the disease-causing agent(s). Virus-free cell cultures using embryonic tissues of Hawaiian green turtles have been established for in vitro studies by the USGS National Wildlife Health Center (NWHC). Representational Difference Analysis (RDA) screening for viruses is underway in collaboration with the Institute for Virology in Mainz, Germany.

- Immuno-competence of turtles with and without FP.

  Laboratory techniques have been developed in collaboration with the Honolulu Field Station of NWHC to measure the humoral (antibody) and cellular (cell mediated) immune responses of clinically healthy green turtles held in captivity at the Kewalo Research Facility. Research is in progress to now measure the immunocompetence of turtles in the wild at FP and non-FP habitat locations.

- Role of dinoflagellates as FP tumors promoters.

  Benthic dinoflagellates, *Prorocentrum* spp. have been identified and quantified on algae and seagrass consumed by green turtles in a Hawaii field study conducted with the Florida Department of Environmental Protection. Nearshore coastal foraging habitats of high-risk for FP have a high prevalence and abundance of *Prorocentrum* spp. Non-FP foraging areas (west coast of Hawaii) have very low *Prorocentrum* spp. These dinoflagellates are known to produce okadaic acid, a biotoxin shown to promote tumors in mice. Preliminary analysis of green turtle tissues has confirmed the presence of okadaic acid.

- Modeling impacts of FP.

  Numerical models and procedures have been developed by Honolulu Laboratory scientist Jerry Wetherall to utilize turtle survey data to provide quantitative assessments of population status and parameters, such as impacts of FP. As an example, growth rates at Palaau, Molokai were found to decline almost linearly with tumor score, whereas the relationship with carapace length (size-class) is significantly non-linear (Fig. 4)

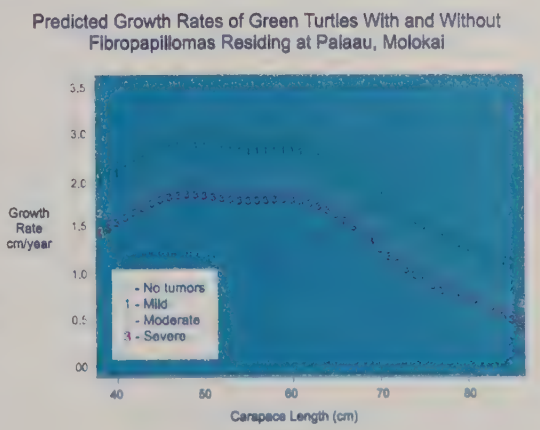


Figure 4

- Modes of FP transmission.

  The University of Hawaii is analyzing remote videotape of the cleaning relationships between Hawaiian reef fishes and green turtles to provide baseline data on the potential role of carnivores transmitting FP between turtles. Turtles with FP may also be deterred from visiting cleaning sites due to painful bites to tumors by fishes. Tissues from cleaner fishes are being tested for oncongenic viruses.

- Trends in nesting.

  The use of a quantitative model to analyze green turtle nesting abundance at French Frigate Shoals indicates a continuing long term upward trend (Fig. 5).

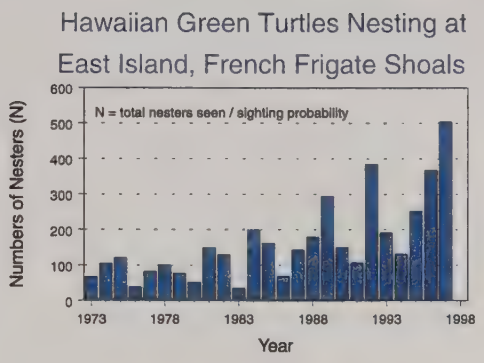


Figure 5

- Mexus Pacifico FP research of olive ridleys.

  Dr. Javier Vasconcelos, director of the Centro Mexicano de la Tortuga INP research facility (Oaxaca) participated in the 1997 Fibropapilloma Workshop convened by the Honolulu Laboratory. In April 1998 Dr. Vasconcelos and two members of his veterinary research staff spent 10 days at the Honolulu Laboratory for collaboration and training. In June 1998 a JIMAR epidemiologist and Colorado State University pathologist will visit Dr. Vasconcelos' facility under Honolulu Laboratory sponsorship to convene an FP training workshop to be attended by researchers from the entire Pacific coast of Mexico. A preliminary study of the histopathology of FP in olive ridley tissues submitted from Costa Rica has been accomplished.

Plans–The research currently in progress as noted above will be continued in FY 1999. In addition, as certain studies come to their appropriate conclusion, research will be expanded and enhanced in the following areas:

- Mexus Pacifico FP collaboration.

- Role of coastal ecosystem stresses and biotoxin-producing dinoflagellates in promoting FP.

Resources

- FY 1998

  One staff-year NMFS labor; 2.5 staff-year labor JIMAR Research Associates and 0.25 staff-year JIMAR Veterinary Researcher funded by add-on RPS competitive projects.

- FY 1999

  Same as FY 1998. RPS project proposals will be submitted to F/PR.

Fisheries Oceanography

Background–The following questions regarding the dynamics and management of resources have been raised by scientists and managers relative to our NWHI lobster and pelagic longline fisheries:

- In 1989 recruitment of spiny lobster to the trap fishery at Maro Reef collapsed and has never recovered yet at Necker Island 670 km to the southeast recruitment and spawning biomass remain strong. Spiny lobster have a larval period of 12 months; why doesn't the spawning biomass at Necker Island result in recruitment at Maro Reef?

- In 1994 swordfish CPUE in the Hawaii longline fishery dropped by over 20% from 1993 levels. Was this drop the result of overfishing or due to environmental change?

- Loggerhead turtles, a protected species, are occasionally caught by the longline fishery targeting swordfish. Do loggerheads and swordfish use different pelagic habitats so careful targeting by the fishery might minimize the turtle catch?

During FY 1998 we addressed these questions using a complementary set of data sources including new satellite sensors, specifically ocean color and altimetry), oceanographic cruises, fisheries logbook data, and animal-borne instruments.

Approach

- Use SeaWiFS ocean color and TOPEX altimetry data set to describe ocean features and surface chlorophyll from satellite remote sensing.

- Use oceanographic cruises to collect surface-subsurface physical and biological data to verify and expand on the satellite remote sensing data.

- Use fisheries logbook data to develop fishery dependent indices.

- Use Argos transmitters on loggerhead turtles to describe movement of turtles in the vicinity of the longline fishery.

Results--An analytical procedure was developed to estimate geostrophic currents every 10 days from TOPEX/Poseidon satellite altimetry. This procedure has been ground-truthed with *Townsend Cromwell* cruises and shown to accurately identify oceanic fronts and eddies -- features with considerable biological significance. In one application the currents estimated from altimetry were used to simulate transport of lobster larvae released from various banks during their 12-month pelagic period. The results showed there are substantial differences between banks in the proportion of larvae they retain from resident spawners as well as the proportion of larvae received from other banks. In particular, the results indicate that larval transport from Necker Island to Maro Reef is minimal, which provides an explanation of why the spawning population at Necker Island does not provide recruitment to Maro Reef, 670 km to the northwest.

Regarding concern about the 1994 decline in swordfish CPUE, the answer was again provided by TOPEX/Poseidon satellite altimetry. Monthly and seasonal changes in sea surface height measured by the satellite provides an index of the change in the vertical thermal structure because of the expansion and contraction of sea water as the ocean warms or cools. We've observed an inverse relationship between swordfish CPUE and sea surface height with CPUE increasing (decreasing) and sea surface height falls (rises) (Fig. 1). The swordfish forage habitat is likely bounded at depth by a lower temperature isotherm. A drop in sea surface height represents a cooling of the vertical thermal structure corresponding to a shoaling of the temperature isotherms which concentrate swordfish closer to the surface and hence increase CPUE (Fig. 2). A rise in sea surface height represents a warming of the thermal structure which corresponds to a deepening of the temperature isotherms which expands the vertical extent of swordfish forage habitat and lowers CPUE. In 1994 the seasonal change in sea surface height in the fishing ground was

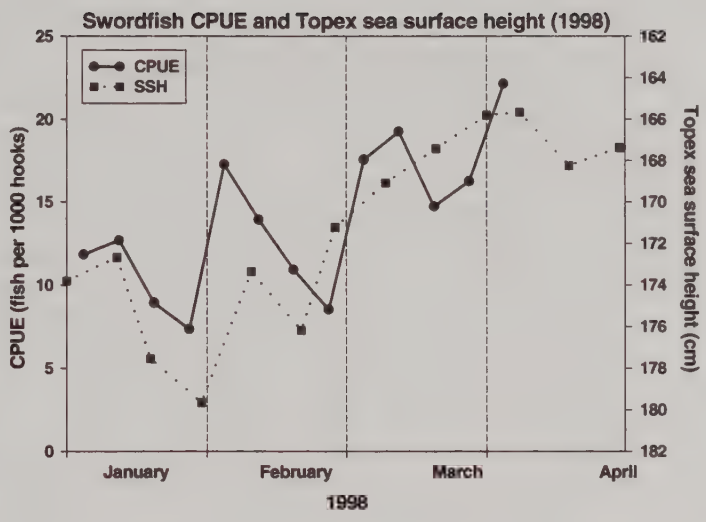


Figure 1. Average weekly swordfish CPUE vs. Topex sea surface height (SSH) for the region bounded by 27°-33°N lat. and 172°-148°W long. Note the inverse scaling for the Topex SSH.

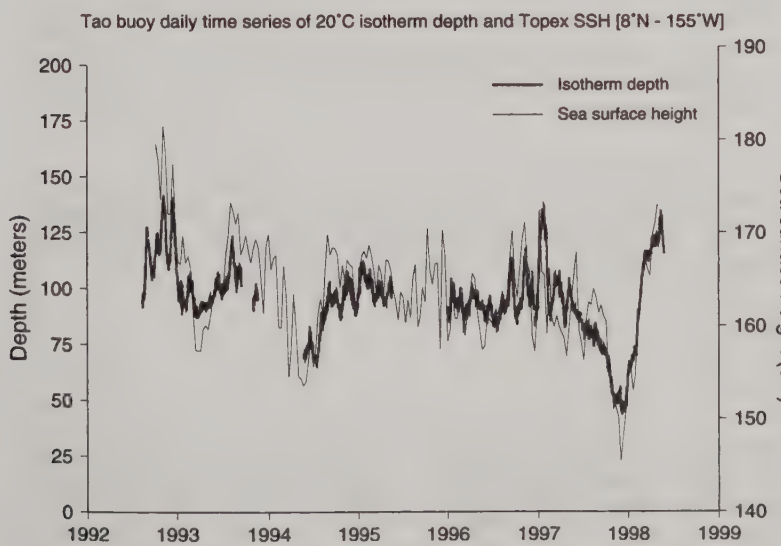


Figure 2. Comparison of daily 20°C isotherm depth (m) from TAO buoy data and averaged Topex sea surface height (cm) over 5° lat. x 5° long. box around TAO buoy location 8°N 155°W.

relatively weak indicating an unusually warm thermal structure; hence, swordfish forage habitat may have extended deeper than usual, resulting in low swordfish density and CPUE.

The loggerhead turtle habitat issue was addressed in a collaboration with the Lab's Marine Turtle Research task by combing information on loggerhead turtle movement in the Subtropical Frontal Zone collected from Argos transmitters and information on the location of swordfish fishing ground together with a description of the Subtropical Frontal Zone derived from information provided by TOPEX and SeaWiFS satellites and our Subtropical Frontal research cruises. The satellite and cruise data show there are two fronts in the lower portion of the Frontal Zone. The southern front frequently lies between lat. 28°-30°N and is characterized by a geostrophic meander with a weak surface chlorophyll expression but strong subsurface chlorophyll maximum. The northern front frequently lies between lat. 30°-32°N and is characterized by a sharp surface chlorophyll front with a very weak geostrophic flow. Turtle tracking data suggest loggerhead turtles forage along the more northern front while swordfish fishing grounds are along the southern front. Interactions between turtles and the fishery may occur if the two fronts merge, if turtles move south of their foraging front, and longliners move north of their target front. This finding, if confirmed with further data collection and analyses, indicates that loggerhead turtles and the swordfish fishery use different ocean features. This information provides new insight to loggerhead bycatch and may suggest ways to reduce loggerhead turtle bycatch in the longline fishery for swordfish.

Plans–Continue analyses of the loggerhead tracking data, the swordfish fishing grounds, and the Subtropical Frontal Zone oceanography to confirm the preliminary results. Use TOPEX data to estimate a standardized swordfish CPUE time series, which adjusts CPUE for changes in thermal structure in the fishing grounds, to be used for stock monitoring and assessment. Begin studies on the oceanography of the longline fishing grounds for bigeye and yellowfin tunas. Some preliminary data suggest that good fishing grounds for tunas around Hawaii occur when eddies interact with seamounts and ridges. Again catch rate data from the longline logbooks and oceanographic data from cruises and satellites will be used to investigate the environmental factors which influence variation in catch rates in Hawaii's longline tuna fishery.

As data from archival tags on tunas and swordfish become available we will collaborate to combine these data with descriptions of the physical and biological features to obtain insights into the habitat of these fishes. We will also develop spatial movement models driven by foraging habitat condition estimated from satellite data.

Resources

- FY 1998

  Three staff-year NMFS labor, 0.5 staff-year JIMAR/PFRP funding (ending 11/98). One 25-day *Townsend Cromwell* oceanographic cruise. Argos transmitter covered by Marine Turtle Research task.

- FY 1999

  Three staff-year NMFS labor, 1.0 staff-year swordfish funds, 1.0 staff-year NESDIS funds, two 15-day *Townsend Cromwell* oceanographic cruises.

APPENDIXES

APPENDIX A

HONOLULU LABORATORY PUBLICATIONS
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APPENDIX B

MISSION STATEMENTS

Investigation Chiefs Team

The mission of the Investigation Chiefs Team is to provide direction and leadership, plan, establish policies, resolve issues, allocate resources, coordinate activities, and represent the Honolulu Laboratory. We achieve our mission by facilitating two-way communication, building trust and a positive lab spirit, stimulating discussion, and motivating and rewarding our people.

Guiding Principles

- Maintain integrity and honesty - scientifically, professionally, and personally.
- Demonstrate appropriate leadership skills and behavior.
- Act with benevolence (be understanding, forgiving, and caring)
- Strive for excellence.
- Nurture mutual respect and trust in relationships (be supportive, positive, and respectful).
- Cultivate loyalty and commitment.
- Be realistic and use foresight in problem solving.
- Be accountable and maintain credibility.
- Demonstrate persistence and tenacity.
- Always operate with purpose, direction, and timeliness.

Oracle Team

The mission of the Honolulu Laboratory Oracle Team is to support better fishery management and protected species recovery, by providing uniform data management that will increase efficiency, improve access to data by other laboratories, facilitate the research and interdisciplinary data analysis.

Guiding Principles

- Cooperation and teamwork.
- Tolerance and willingness to listen to others.
- Honesty, openness, and trust.
- Respect for each other and for our priority needs.
- Willingness to participate and to learn.
- Supporting other team members in development of skills.
- Working hard and realistically.
- Giving and accepting appropriate feedback in a positive manner.
- Being respectful, resourceful, responsive, and responsible.
- Operating always with purpose, direction, and timeliness.

Monk Seal Team

The mission of the Honolulu Laboratory Monk Seal Team is to take action to achieve and maintain an optimal sustainable Monk Seal population. We aim to enhance our understanding of the Monk Seal, and to develop and maintain the scientific background necessary for recovery of the seal population.

We achieve our mission through dedication and hard work, valuing truth, integrity, and accuracy. We are committed to honest, open and responsive communication, teamwork and supportive professional relationships.

Guiding Principles

Remain focused on and committed to our vision, recognizing and accepting our roles and responsibilities in the goal of recovery.

- Act with Wisdom while applying the Scientific Method.
- Strive for Excellence in scientific investigations.
- Support and endorse the principles of conservation, with respect for the diversity of all life forms and for the environment.
- Show respect and consideration for each other.
- Promote public education to advance our goals.

Swordfish Research Team

The mission of the Swordfish Research Team is to contribute high quality science to local and international Pacific swordfish management. With a commitment to sound, factual, timely high quality science, we function as a team to: plan, coordinate, and review swordfish research.

We achieve our mission through dedication and hard work, operating with a pledge to integrity, accuracy, scientific validity, truth and timeliness. We commit to mutual support and individual responsibility.

Demonstrating stewardship for the sea, our theme is *Malama i na waiwai o'ke kai* (Hawaiian for "caring for the resources of the ocean").

Guiding Principles

- Use the best scientific information available.
- Advance swordfish fisheries science
- Ensure conservation and maintain the viability of the U.S. swordfish industry through sound practice of fishery management.
- Identify multi disciplinary requirements and promote effective communication and teamwork among swordfish researchers.
- Openly exchange information
- Be enthusiastic, fair, and professional.